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The Shipping Situation

THE returns of the American Bureau of Shipping, as of July 1, show a decrease in shipbuilding orders held by American yards, as compared to April 1, of approximately 8½ percent. The report of Lloyd's Register of Shipping indicates a reduction in American orders held, of 13 percent for the same period. Apparently, the British returns do not include certain tonnage covered by the American Bureau report, but in any event it cannot be denied that the shipbuilding situation leaves a very great deal to be desired.

A little reflection, however, will show that present conditions, in view of their underlying causes, which were quite abnormal, were to have been expected—in fact, were inevitable.

The general dislocation of world trade, brought about by the war, is, even now, far from being satisfactorily adjusted. More than any other industry, shipping is sensitive to international relations. Apparently it is the first to feel and the last to fully recover from the effects of a disturbance of normal conditions.

It seems to be pretty generally agreed that the low point of international trade has now been passed, an index of which is the improvement in shipbuilding in other countries than our own and amounting, according to Lloyd's report of June 30, to about 4.9 percent, as compared with the first three months of the year. Until, however, political conditions, particularly in western Europe, are established upon a firmer basis than now exists, it is idle to expect any material improvement in the trade between the different nations directly concerned, or, for that matter in commercial relations the world over.

In addition to the depressing influences outlined above, which, in common with that of all other countries, the shipping of the United States has to bear, there are other conditions, peculiar to this country alone, which add materially to the difficulties faced by its shipbuilding and ship operating interests.

The successful prosecution of the war was largely dependent upon the ability of the Allies to keep in active operation a very great number of merchant vessels and, as the war progressed, it became more and more the special office of the United States to supply these as rapidly as they were needed. While it is true that only a small part of the new construction undertaken by the Government, after we entered the war, saw actual service before the armistice was signed, it is not to be denied that the psychological effect upon the enemy of the building of the enormous government fleet was an important factor in bringing the war to a close in 1918.

The war left us with a fleet far in excess of any probable peace time requirements and, while it is easy now to point out the mistake of carrying on to completion many of these vessels, after hostilities had ceased, one has but to remember the unprecedented demand for merchant tonnage in 1919 and 1920 to realize that there was abundant excuse for this action, notwithstanding the probability of an eventual disastrous reaction.

Unfortunately these surplus ships are all of the tramp type, while the general tendency of ship development is towards cargo liners—vessels of materially greater power and speed and of more moderate deadweight capacity. The fact that the Shipping Board vessels can be had for from $25 to $30 a deadweight ton, and yet go begging, seems to prove, pretty conclusively, that there is little demand for ships of the tramp type, in this country, at least, at any price, but the mere existence of these low priced vessels has a most prejudicial effect upon the building of new vessels, of any type. To the investor and banker "a ship is a ship" and the fact that any vessels can be obtained for $30 a ton acts as an effectual preventive of the construction of new ships at three or four times that amount, no matter how superior they may be in every particular.

We by no means wish to appear as advocating the wholesale destruction of the government cargo vessels. Many of

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them are, or can be made, first class competitive ships, and in the revival of trade which eventually is bound to come, a use will be found for them. There is, however, a large part of the fleet, which in all human probability, and barring the advent of another war, will never again be used. They are a source of continuous expense and contention, and the only part they play, or ever will play, as regards the merchant marine, is to retard its normal and healthy growth.

It is much more important to the general commercial prosperity of the country that the shipping lines should be enabled to build modern vessels, suited to their needs, and the shipbuilding industry kept alive, than that a fleet of ships, which are steadily depreciating and whose greatest value at the present moment is on the scrap pile, should be kept afloat under the plea of preserving the taxpayers' property. The fact that the Fleet Corporation will probably have to continue its ship operating activities for some time to come, on account of foreign trade conditions, if for no other reason, in no wise affects the status of the large fleet of non-competitive ships which it has in its charge. From every point of view it appears desirable to dispose of these vessels by scrapping at the earliest possible date.

Turning to the question of the continued government operation of merchant ships; while it may be looked upon in certain quarters as an unnecessary evil, it must be remembered that with present conditions, this operation is mandatory and that by it alone the flag is kept, in any appreciable force, upon the high seas.

Leaving out of consideration the national and political sides of the question, it cannot be denied that in certain ways government operation is resulting in a very distinct advantage and gain to the merchant marine. First and foremost it is bringing into active touch with the problems of ship operation a large body of men and through them reaching a considerable proportion of the population who, under ordinary circumstances, would have little knowledge of or interest in marine affairs. Secondly, by means of the large number of highly skilled and expert engineers in its employ the Fleet Corporation is enabled to carry out studies and investigations of various problems and effect systematic improvements in operation, usually quite outside the scope of the engineering staff of a private shipping company. The results of the work of the Fuel Conservation Committee, for example, are an outstanding illustration of constructive work which cannot fail to be of the greatest advantage to the whole merchant marine in building up a strong asset of first hand knowledge and practical experience, impossible to attain in any other way.

So far as the engineering side of operation is concerned, the Shipping Board vessels have, almost without exception, shown a steady improvement during the past year and compare very favorably with privately owned ships—both American and foreign.

Whatever opinions may be held as regards the general policies and activities of the Shipping Board, it is evident that its operations are resulting in giving to the country a large body of men trained in and familiar with the problems of ship operation on a large scale—something which has not existed since the days of sailing ships, and without which it is unreasonable to expect success in any national movement having as its object the substantial building up of the merchant marine.

The Jones Act requires governmental operation of essential trade routes until it is possible to dispose of the ships to private owners. It is idle to expect this consummation until some practicable means is found of overcoming the differential existing against American operation. This means was provided for in the Act by the discriminating duty and tonnage dues clauses. Up to the present time, these clauses have not been put into active operation, and there is little probability that they will be, in the near future. Certain of the government operated lines are showing a small profit over operating expenses, in the face of sharp competition. If capital charges were taken into account, these same lines would show an annual deficit of approximately 10 percent. It is evident, then, that the differential operating against the profitable operation of American vessels in foreign trade amounts, at present, to at least 15 percent on a fair valuation. Until some means is found to remedy this condition, privately owned American vessels are not likely to be found in foreign trade, except, possibly, in a few very special cases.

General improvement in trade will tend to increase the profits or reduce the losses of ship operation, so that it may come about with more normal conditions that the deficits resulting from American operation will be reduced, but they can never be entirely wiped out by this means alone, and it would appear that government operation in the overseas trade is likely to continue for an indefinite period.

The war left the country with a surplus of shipyards, as well as of ships, and this surplus has been accentuated by the disarmament agreement. For many years, the larger American yards have been dependent upon naval work for the greater proportion of their output. With this removed, it is evident that a considerable proportion of their capacity must eventually be devoted to other lines than shipbuilding.

The opening of the Panama Canal has increased the potential demand for American merchant ships, and once the surplus and non-competitive government vessels are out of the way and general trade conditions are in a fair way of becoming settled, it seems reasonable to expect a moderate, but fairly steady demand for ships, not such, however, as would fully employ the enormous increase in ship producing capacity brought about by the war.

It appears, then, that our shipping and shipbuilding are suffering from poor trade, in common with all shipping, and from their own over-capacity of ships and shipyards.

World trade seems to be taking a slight, but definite upward turn. With the Dawes report, a start has been made towards the rational settlement of Europe's international difficulties, and when the recommendations of this report are put in force, which it would seem must eventually be brought about, a material and general improvement in trade is likely to follow.

As to our own peculiar difficulties, a start has been made, in the Diesel program, to dispose of the government vessels, and we do not believe the Shipping Board can much longer delay a general clean up of undesirable and surplus tonnage. So far as the shipyards are concerned, what may be considered a normal total capacity, which can be kept reasonably busy, cannot well be determined until the shipping business

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has become fairly stabilized. In the meantime, it is interesting to note that during the past four months, orders have been placed in American yards for vessels of good tonnage, of an approximate total value of $13,640,000—this to meet requirements which could not longer be neglected.

Standardization

PERHAPS the most important development now going on in the practical side of shipbuilding is the attempt being made, both in this country and abroad, to standardize the details of ship construction.

Efforts to standardize types and sizes of vessels have been made from time to time, without any great degree of success, except in a few individual and very special instances.

While the requirements of any particular line of trade lead to the development of a type of ship peculiarly fitted to meet special conditions and, in a sense, standardized, the ordinary demands of commerce are not such as to warrant the production of ships on a strictly standardized, or manufacturing, basis and the individual ideas of particular owners outweigh the possible gain to be had from the bulk production of ships.

However, a great deal may be, and in certain instances has been, accomplished in the production of standard vessels, for instance, on the Great Lakes; but it does not appear probable that the mass of ocean transportation will ever be done by stock ships, built to definite sizes and on common specifications.

The construction of ships has been simplified and the variations in types of framing and similar structural details are less than they formerly were. It may be said that methods of construction are approaching standardization, but its details, except in so far as they are governed by the rules of the classification societies, are still determined by the judgment of the individual designer or draftsman. Simplification of structural design may easily be carried too far, particularly if it reaches the point where the sea-worthiness and propulsive qualities of the vessel are in any way adversely affected. During the war many ships were constructed which departed more or less radically from what is usually considered good practice by regular shipbuilders. When the circumstances under which these vessels were built are taken into consideration, it may well appear that the abandonment of certain generally accepted principles of good ship construction were justified by a resulting saving of time, and possibly of money. Under normal conditions, however, with a vessel constructed in a real shipyard and by experienced shipbuilders, we do not believe that any appreciable saving results from such practices as the abandonment of all sheer and the fitting of flat bottoms and decks; while it cannot be denied that they have a prejudicial effect upon the practical operating qualities of the vessel.

Although a standard system of construction might be evolved without recourse to features of design which are more or less prejudicial to successful operation, the demand for individual types of vessels under nominal trade conditions is not sufficient to warrant the building of stock ships in large quantities, and it does not seem probable that this manner of production will ever obtain, to any great extent, except under such abnormal conditions as were brought about by the world war.

Nevertheless, certain shipbuilding companies have, at times, attained considerable success in the construction of standard type vessels. Some fifteen or twenty years ago Russell & Company of Glasgow, Scotland, held on one or two occasions, the world's record for annual ship production, and we believe that this large output was comprised mainly of two sizes and designs of vessels which might properly be called standard. These vessels were produced at a low cost and the manager of Russell & Company at that time, Mr. Lambie, told the writer that in most cases the shipowners who came to them for vessels were willing to set aside, to a great extent, their own ideas in regard to design and details, in order to take advantage of the lower prices which the standard designs made possible.

At the present time, one or two shipbuilders in Great Britain are making an effort to standardize the construction of motorships, a development which is mentioned in an article from our London correspondent published elsewhere in this issue. In one case, the duplication, or standardization, so far has been applied only to the vessels of one line, but this involves a total of about fifteen ships. On the other hand, Messrs. Doxford are producting a standard motorship of about 8,000 tons deadweight for several different owners. It will be very interesting to note how far it will be possible to carry this method of production.

While the standardization of vessels, as a whole, or of ship design, may not be developed to any very great extent in this country, in the near future, there seems to be no good reason why a standardization of details, particularly as regards fittings and equipment, should not be carried out. In Great Britain, largely, we believe, as the results of the efforts of Sir Archibald Denny, a committee has been formed which is making notable progress in this direction, and whose work is apparently receiving favorable consideration from shipbuilders. In this country, about a year ago, the American Marine Standards Committee was formed, having in view the same objects as those of the British committee. The work of the American committee at once enlisted the favorable consideration of Secretary Hoover and the Division of Simplified Practice of the Department of Commerce, and the initial work of the committee is being undertaken with the active co-operation of the government bureau.

Some of our shipbuilding friends, with whom we have discussed this matter, seem inclined to belittle the attempt to standardize the details of ship construction, their contention being that, as every shipyard has its own set standards, any attempt toward a general standardization would merely tend to further complicate the business without any compensating advantages. While it is true that the standard fittings, as produced by the various shipyards, are usually quite satisfactory, it would appear that the critics really overlook the whole point of the argument. They give no consideration to the very great progress which standardization has made possible in other lines of business, in fact, its absolute necessity. It is only necessary to consider, for instance, the confusion which would arise from the abandonment of standards in the manufacture of ordinary pipe or electrical fittings, to visualize what standardization of details really means, both to

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the manufacturer and the consumer, and we can see no valid reason why the standardization of marine fittings and equipment is not equally practicable and possible of producing results of as great a value.

Standardization is today the most important approach to greater industrial efficiency. The magnitude of the yearly savings resulting from it is almost incredible. In the automobile industry, there is a saving now being made through the application of standardization which is figured at approximately $750,000,000 a year, and it is these savings which have made the automobile generally available instead of its being only a luxury for the rich.

It is significant that the problem of putting greater efficiency into the conduct of the war turned out to be largely a problem in standardization. Some of its greatest tragedies were due to the lack of standardization. The great British drive is said to have been postponed a year by ammunition which would not fit. On the other hand, some of its greatest successes were made possible by standardization. In the case of the mining of the North Sea, for instance, four hundred factories in the United States and Canada, each working upon some small part of a mine, were able to turn these parts out in prodigious quantities, and yet so accurately were they made that the assembling in Great Britain was done without difficulty. The British tank building program was handled in a similar manner.

Turning to peace time activities, there is no doubt that the greatest single waste in industry is due to failure to carry out the process of standardization in a thoroughgoing way. As illustrating this condition, it may be cited that one firm is making 7,500 different varieties of bed castors; three axe manufacturers are making common axes in 34 types, 4 grades, 35 brands, 11 finishes and 19 sizes, 6,118 varieties being actually listed.

While the condition thus described has been the natural result of the individual development of various firms, the point has been reached where it becomes not only an advantage but a necessity that superfluous production of similar articles should be, to the greatest possible extent, eliminated, and it was with this in view that the Division of Simplified Practice of the Department of Commerce was formed.

As giving a clear and illuminating illustration of what has already been accomplished by the efforts of the Division of Simplified Practice, the following table is of very great interest:

	Reductions in Varieties	
	From	*To*
Vitrified Paving Brick	90	29
Beds, Springs and Mattresses	78	4
Metal Lathes	125	24
Woven Wire Fencing	552	69
Woven Wire Fence Packages	2,072	138
Hollow Building Tile	36	19
Rough Face Brick	39	1
Smooth Face Brick	36	1
Milk Bottles	49	9
Hotel Chinaware	700	160
Range Boilers	130	13

The above reductions, recommended by the Division of Simplified Practice, have been approved and accepted by the industrial groups manufacturing the various articles.

Aside from the manifest saving resulting from the reduction in number of patterns, drawings, jigs, etc., used in manufacture, the advantage to be derived by all concerned, both in the manufacture and use of the various articles, from the reduction in number of different types and sizes can hardly be over-estimated.

Turning to the marine field, while the duplication of effort represented by similar fittings of slightly varying types and sizes is not so great as that which obtains in other industries, it is quite obvious that the adoption, in so far as it can possibly be brought about, of uniform standards would be of the very greatest advantage, for there is hardly any detail entering into the construction of a vessel, particularly as regards its fittings and outfit, which cannot be standardized.

As an example of one description of articles with which, at first glance, it might be considered a waste of energy to attempt any general standardization, crockery and glassware may be mentioned. We believe that every ship draftsman of long experience can recollect occasions when the preparation of the drawings for, or the actual finishing up of, a pantry or a galley has been seriously delayed by the non-receipt from the shipowner of samples of the types of china and crockery used on his vessels. This might have been obviated by the knowledge that the stowage racks or lockers had simply to be constructed to receive china and other articles of standard dimensions. Items of this sort, while small in themselves, become large in the sum total of a completed vessel and have a very material effect upon the time of completion and the cost.

It is undoubtedly a somewhat difficult matter to know just how far standardization may be carried to advantage. We have understood, for instance, that the British committee has had under consideration the standardization of stern tubes. This would appear somewhat impracticable as it may be conceived that a standard length of tube might very possibly conflict with both classification rules and the ship's model, but, on the other hand, if the sole element of length is omitted, there seems to be no good reason why the other dimensions of the stern tube could not be fixed on a basis of the diameter of the tail-shaft.

However, even when obvious limitations such as the one mentioned are taken into consideration, there still remain almost limitless possibilities for the application of standardization, and the fact that this work is being actively taken up in this country cannot fail eventually to have a most beneficial effect upon commercial shipbuilding. The Marine Standards Committee, now thoroughly organized, has appointed a large number of sub-committees, each to deal with certain particular parts of the general problem and it is gratifying to note that the large shipyards are co-operating with the committee in the carrying out of its extended program.

The high prices of material and labor in this country have, in general, prevented its shipbuilders from successfully competing with foreign yards. This very fact, however, appears to call for a united effort to reduce the cost of American vessels. Our ships may not be able to enter into foreign trade on equal terms with those of foreign owners but every effort which decreases their cost without impairing their efficiency is a step toward making them profitable investments.

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What Will Be the Future Development of Steam Pressures and Temperatures for Marine Work?

By Commander S. M. Robinson, U. S. N.*

For many years past marine practice has been in the lead in the use of high pressure steam, but recently the practice on land has not only approached that of the sea but plants are now under construction, or proposed, for power stations which contemplate the use of pressures far beyond anything that has been proposed for marine work. The advantages of high pressures and high temperatures are so well known and have been so thoroughly discussed that they call for no special comment but in this article will be found a timely discussion of the difficulties of utilizing these advantages on board ship.

VERY little change has been made in the steam pressure used on board ships for a good many years, although there has been a fairly steady increase in the amount of superheat used. This retardation of advancement has no doubt been due largely to the difficulties of design of high pressure boilers and the difficulties attendant on getting suitable materials for high temperature work generally. In spite of these difficulties, however, the advantages to be gained are so great that it is not believed that the marine world will be able to resist the present rapid advance in the use of high pressure steam.

The problems that are brought up on board ship differ in many important particulars from those that have arisen on land, and we may therefore reasonably expect somewhat different conclusions to be reached in regard to the proper balance between advantages and disadvantages of high pressure steam. These problems will be discussed in order.

Pressure to be Selected and Temperature Limits to be Set

At the very outset it may be said that the most difficult problem for the marine engineer will be the design of a boiler suitable for high pressures. Piping, valves, expansion joints, turbine blading, etc., will all be sufficiently difficult but none of them compares with the difficulty of boiler design. In the first place, the present boiler efficiencies must be maintained or we may lose more than we gain; also the space and weight limitations are very definite. Therefore the pressure to be used for marine work at the present time will be decided largely by the limitations of boiler design and future developments in the increase of pressures can only take place after a radically different type of marine boiler is produced.

Boiler pressures at the present time range from about 200 pounds on commercial ships to around 300 pounds on naval ships, the former pressure being used generally on both firetube and watertube boilers. The design of marine boilers differs very materially from that of those used in land installations. However, it is believed that a pressure of about 450 pounds can be used without departing from present established methods of design, and, therefore, this would seem to be a conservative pressure for the first high pressure marine installations. By not going beyond this pressure the number of problems that will have to be solved will be materially reduced. If this pressure is exceeded very much, it will be necessary to evolve a type of boiler very different from that used on board ship at the present time.

In regard to temperatures, for geared installations having backing turbines, it is believed that a limit of 550 degrees F. should be established; for electric drive ships a limit of 700 degrees F. should be satisfactory.

These selections may appear to be conservative in the matter of pressures and radical in the matter of temperatures, but materials already in use in naval vessels and in many shore establishments have demonstrated their suitability for temperatures as high as 700 degrees F. while the design of a suitable high-pressure boiler for marine installation is something still to be accomplished.

In regard to setting a limit of 550 degrees F. for geared turbines, this limit has been set as the result of experiments made to date. The development of materials for turbine blading and wheels may make it possible to increase this limit in the very near future.

Effect of High Temperature Steam on Boiler Performance

The effect of high temperature steam on boiler efficiency is of the greatest importance for marine installations; especially is this true in naval ships where the use of heavy economizers is forbidden on account of the great weight and space required for their installation. Therefore this question has to be very carefully considered as it might very well be that the greater part of the gain in the turbine efficiency might be lost in decreased boiler efficiency.

As stated above, commercial practice on board ship has so far been limited to around 200 pounds, while naval practice has gone as high as 300 pounds pressure. The former pressure has been used with both firetube and watertube boilers. Of the latter type of boiler, comparatively few of the express type have been used on commercial ships, most of them being of the large tube type. In going to the higher pressures it will, of course, be necessary for commercial ships to abandon boilers of the firetube type and the materials used will also have to conform more strictly to those used in the naval service at the present time.

Oil-fired marine boilers at the present time give an efficiency of about 75 percent when burning oil at the rate of 1 pound of oil per square foot of heating surface and around 80 percent when burning oil at one-half that rate. The former rate is generally used in the naval service, while the latter is more common in commercial ships.

The temperature of steam of 300 pounds pressure is 417.5 degrees F. while that at 450 pounds is 456.5 degrees F., or a difference of 39 degrees F. In order to maintain the same exit temperature of smokepipe gases as is now possible, it will be necessary to increase the number of rows of tubes in express type boilers, and this will result in an increase of boiler weight of about 5 percent. This seems to be the advisable method of reducing smokepipe temperatures for naval ships, although in the case of commercial ships where weight is not such a factor it may be possible to use economizers or air heaters as well for the same purpose. It appears, therefore, that there will be no difficulty in maintaining present boiler efficiencies with the increased temperature due to an increase of pressure to 450 pounds, although with a slight

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increase (maximum of 5 percent) in boiler weights. This method of maintaining boiler efficiency is, of course, very limited in its application as the number of rows of tubes very soon becomes so great as to build up undesirable back pressures in the furnace.

In connection with the subject of smokepipe temperatures and width of tube bank, the reader is referred to a paper on "The Dyson Boiler," by Lieutenant Commander H. G. Cooper, U. S. N., in the February, 1922, issue of the *Journal of the American Society of Naval Engineers.*

Effect on Pipe Lines and Valves

It is believed that present materials in the naval service will suffice for the temperatures and pressures indicated. However, the design should be made with the object in view of reducing the amount of steam piping as much as possible, and a method of accomplishing this will be indicated later.

The greatest difficulty presented will be that of making joints. Inasmuch as space requirements render it impossible to make the necessary allowance for expansion by large bends, as is done in land installations, it will be necessary to follow the usual marine practice of installing expansion joints. It is believed that suitable packing is available at the present time for use in these joints although frequent renewal will probably be necessary. Also, owing to the necessity for more frequent overhaul and removal of sections of piping, the practice of welding flanges would also be unsatisfactory. It is believed, however, that for pressures not in excess of 450 pounds the present marine practice in making joints will be satisfactory, although it will be necessary to modify flange diameters and change bolt circle diameters and the number of bolts. Also, it will be possible to use some modification of the Van Stone joint and this will undoubtedly be necessary when further increases of pressure are made.

Here again it will be necessary for commercial ships to use higher grades of material than they have used in the past. Seamless steel piping and steel valves with monel metal trim will doubtless replace present materials used on commercial ships.

Effect on Auxiliaries

With steam containing the amount of superheat proposed, it will be necessary to abandon reciprocating auxiliaries entirely, except for emergency purposes, as it will be out of the question to provide lubrication for steam cylinders; when generating steam in boilers at 450 pounds pressure, the purest feed water possible will have to be insisted on. It will, therefore, be necessary to drive all auxiliaries by turbines or motors.

It is believed that the number of electrically driven engine room auxiliaries on board ship should be enormously increased for two reasons. First, this will reduce very greatly the amount of high pressure steam piping necessary and, second, it will add to the efficiency of the entire plant. Undoubtedly one of the points causing greatest waste in marine installations at the present time is the poor choice of main engine and ship auxiliaries, and these could be very greatly improved upon even with present pressures and temperatures.

When it is remembered that power for auxiliaries can be generated at the rate of about 14 pounds per kilowatt and that average motor efficiencies of 80 percent can be obtained, thus giving an overall water rate of a little over 13 pounds per horsepower for all auxiliaries, it should make anyone carefully consider the use of additional electrically driven auxiliaries on board ship. Nowadays one seldom hears the old argument advanced that the water rate of the auxiliaries is a matter of no consequence since the auxiliary exhaust is used for feed heating. Nevertheless this fallacy has probably been more responsible for the backward situation in regard to auxiliaries than anything else.

One of the first effects of the adoption of electrically driven auxiliaries will be a reduction in the amount of auxiliary exhaust steam available for feed heating purposes. Undoubtedly the reduction will be so great as to necessitate supplementing the auxiliary exhaust for feed heating by bleeding steam from the generator turbine or the main turbine itself.

Cycle to Be Used

Here again it is believed that some modification will have to be made of the practice in use or proposed for land installations. For example: it would seem to be impracticable, in naval vessels at least, to resort to interstage heating of the steam. This would lead to great complications in piping and, what is of even greater importance, more complication in operation of the plant. It is not believed that the results obtained justify the additional weight and complication, although it is possible that a compromise in this respect might be worked out for some commercial ships where the distance between boilers and turbines is very short.

As mentioned above, the reduction in the number of steam auxiliaries will make it desirable to bleed a certain amount of steam from the main turbines for feed heating purposes. This again results in undesirable complications in piping and in the methods of operation, owing to the widely fluctuating loads on board ship, but it is believed that a satisfactory installation in this respect can be worked out so that a proper heat balance can be obtained.

In a description of the proposed Colenso power station of the South African railways, it is noted that the feed water passes through four stages of heating before reaching the main feed pumps and through one stage after leaving them. The first stage uses the drains from the succeeding heaters bringing the feed water from 88 to 93 degrees F.; this stage consists of two heaters in series. The feed next passes through the second stage of heating which brings it up to 135 degrees F., steam being supplied from the turbines. The third stage brings the feed temperature to 145 degrees F. using steam from the secondary nozzles of the air ejectors. The fourth stage brings the temperature to 180 degrees F.; in this case the steam supply comes from the main turbines, being tapped off the interconnecting pipe between the high and low pressure turbine. The feed water next goes to the main feed pumps and then to the last stage of heating where the steam is supplied by the exhaust from the steam driven auxiliaries.

To a marine engineer this seems to be a very complicated method of heating feed water, but close analysis will show that such is really not the case as the system will be flexible so far as changes of load are concerned; the stronger argument against the adoption of such a system is the additional weight and space required. A compromise will have to be effected which will probably result in about three stages of feed heating. The first stage would be in connection with the deaeration of the feed water as will be explained later, the second stage would use steam bled from the main turbine and the third stage would utilize the auxiliary exhaust. The second and third stage heating would be done after the feed water had passed through the main feed pumps.

Necessity for Keeping Air Out of the Feed Water

With the installation proposed it is believed that some method of keeping air out of the boiler feed water becomes necessary; it has always been desirable but it becomes a necessity with the higher pressures. In the first place, there will be less allowance for corrosion and a somewhat reduced factor of safety all the way through with the higher pressure. In the second place, corrosion at the higher temperatures will be more rapid. In the third place, if economizers are to be used, the air must be removed from the water if the economizers are to have any life.

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There are two methods of accomplishing this that suggest themselves at the present time. The first is that of deaerating the water by means of heaters, and the second is the use of an entirely closed system of handling the feed water. The two methods are really the same in principle but differ in arrangement and details. With the closed system, the deaerating is done in the main condenser, the condensate being discharged directly to the main feed pump, the main feed tank being a reservoir from which the condenser draws additional make-up feed or to which the condensate pump discharges surplus feed. With the other system, a special deaerator is provided which removes the air from the condensate after it leaves the condenser. This may be arranged in various ways, the discharge from the deaerator may be sent to a steam-sealed feed tank, thus giving a closed system, or the water may be drawn from an open feed tank and deaerated and then sent to the feed pump direct by an auxiliary pump. The deaerator method of removing air is believed to be more reliable than depending entirely on a closed system for keeping the air out. Also the use of an external deaerator should reduce very much the work of the main condenser.

The "Call of the Sea"

Let Us Have Better Men and More of Them for Our Merchant Marine

By David Gaehr*

IN order to recruit *better* men and more of them for our merchant marine (thus automatically sidetracking undesirables), and to enlist more interest in and sympathy for the splendid fellows of limited schooling, who have demonstrated that they are made of excellent stuff, a program should be mapped out so that a coalpasser, for instance, while filling that position, can improve his mind in a definite manner, be stimulated in acquiring valuable information by observation and, in a year or less, become a fireman. Having secured this first advancement he should be similarly induced to "look up" and struggle upward, gaining further help as water tender and oiler, until he has had the requisite 36 months of experience, entitling him to an examination before the United States Steamboat Inspectors for a license as assistant engineer.

This first examination he should be able to pass without trouble after attending a winter session of a school for such men. There are a number of schools of this kind, some private and in business for "gain," with a correspondingly low educational standard, while others are conducted by vessel owners' organizations similar to the schools conducted by the Emergency Fleet. Having obtained his first license, the recruit should be still further guided while serving in that capacity, until he ultimately reaches the top of the ladder after satisfactorily passing successive tests.

"Turn-Over" of Ships' Crews Costly

In this country the "turn-over" of ships' crews is enormous, an indication of restlessness and of lack of appreciation of the elements of success in a sea-faring career. Sailor men today, in large numbers, are typical "trippers," leaving their ships at the end of the first trip, "spending their substance in riotous living" and, when penniless, "shipping" again with nearly as good chances and for as much pay as is received by men applying themselves seriously to the task of making fine records for themselves and for their ships.

This needlessly costly element in the management of our ships, however, to date is simply temporized with. More shipping offices are opened as the demand for men becomes more acute and men, such as are available, are hired. Thus it is not a matter of the majority of our sailor-men responding to the "call of the sea," but when men cannot secure jobs anywhere else, they go to the shipping offices along the water fronts.

This is not as it should be. *There is no nobler calling than a sea-faring career, sailing under the Stars and Stripes.* The *sea still does "call,"* not in a mysterious manner, but through the agency of true American sailor-men and organizations of men, who recognize the splendid experience a term of years at sea will give to a man of red blood, even though he may not be willing to devote his entire life to this. The vessel owners themselves are the ones who should logically be most interested in passing on this "call" to the thousands of likely young men who would gladly respond, if they only knew of the opportunities offered them for most interesting employment aboard ship with quite satisfactory remuneration.

One never hears of "vocational guidance experts" sending boys to sea. They do not know about sea-faring life. They are not the only ones who are in ignorance as to such matters. During the late war, a great many young men enlisting in the Navy, were assigned to fresh water freighters for some rudimentary training, and all, although born in lake ports, expressed great surprise at seeing the immensity of this arm of commerce and the ships and dock facilities used for handling freight.

It is perfectly clear that if not enough men of the "right type and stripe" are available for manning our vessels, it is due either to the fact that not enough of the young men have been told of the charms and opportunities for promotion in a sea-faring life, or because some of the conditions aboard certain ships are effective deterring influences even for men of the right stuff. Either condition can be corrected and should not be trifled with.

Educational Propaganda Needed

The first case calls for educational propaganda, regular newspaper and trade journal cooperation to attract the attention of promising youngsters *years before they are of age to apply* for positions aboard ship, posters before the public's eye (akin to those of the Army and Navy), addresses before schools, churches and civic bodies, emphasizing the claims of *our merchant marine* on grounds of the meritorious service it has rendered in the development of our country.

The second case is entirely in the control of vessel owners and would be quickly remedied, if they did their own recruiting of crews, instead of leaving that to the employment department of some organization through which various vessel owners pool common interests. If they were unable to ship crews, after certain characteristic and odious features of their vessels become sufficiently advertised at the water fronts, such as: (1) "she's a hard steamer," (2) "she's a poor feeder," (3) "she's a madhouse," etc., etc., they would act promptly to make such designations no longer justifiable. Any good ship, properly equipped, properly manned, properly handled and

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managed, will give a satisfactory account of itself, and things will go smoothly and their crews "cannot be driven off."

VESSEL MANAGEMENT SHOULD BE BASED ON EXPERIENCE

It must be remembered that a ship, or a fleet of ships, cannot be managed by merely holding down a mahogany swivel chair in a modern office building. It requires intimate knowledge of men and conditions aboard the various ships, and that cannot be obtained by proxy, nor from reports. It requires living with the men aboard ship for a certain length of time, and, for best results, requires some actual experience in the various positions on ship board to make possible clear and fair minded consideration to every member of the crew.

Another very important factor in presenting this "Call of the Sea" is the ability to present to interested youngsters a very definite ladder of advancement, placing a captain's or chief engineer's berth within reach of every man willing to pay the price in terms of requisite service record and painstaking acquisition of the necessary technical qualifications. It would be a rather hopeless picture opening up before the mass of our young sailors, active and prospective, if the choice positions aboard ship were open only to graduates of nautical schools—desirable though this be in certain respects.

Even if provision be made for appointing men who have acquired the necessary qualifications by their own effort, provided they can pass the examinations required for appointment to an officer's berth, there would be so few who could thus gain the top of the ladder that the service, as a whole, would suffer, for these practical men, starting at the bottom and steadfastly climbing, are after all the ones upon whom we rely mostly to *"bring the ships around"* safely, in good time, and to keep everything in good repair and "shipshape." Their, as it were, innate good sense and sound judgment particularly in moments of stress and crisis, have been developed by actual experience rather than by book knowledge and class room or lecture work, and that counts for more than many of the desiderata supplied by schools. Experience and technical training must effectively go together—but, if either is to be in preponderance, let's have an extra measure of *experience.*

The very faithfulness of our lads stoking furnaces and oiling bearings, quietly going about their tasks, doing as they are told, and often doing the right thing without being told, demands a remuneration beyond dollars and cents. It demands an opportunity to qualify progressively for the higher positions, for which encouragement and guidance must be supplied by others.

Admiralty Law and Shipbuilding

A RECENT study, by Mr. Theodore F. C. Demarest of the Council of American Shipbuilding, Inc., brings to light the peculiar relations which exist between Admiralty Law and the shipbuilding and ship repairing industries.

The substance of this paper is well summarized in its concluding paragraphs:

"This study will be closed by quoting the language of a thoughtful judge, describing the effect, on his mind, produced by a contemplation of the American doctrine, that a contract to build a ship is not maritime in character:

"I have looked for the reason in order to learn, if possible, how to reconcile the decisions holding contracts for the building of ships to be not maritime with those holding contracts for the repair and rebuilding of vessels to be maritime, and where to draw the line dividing contracts for doing mechanical work, and for furnishing building materials and machinery, which are classed as non-maritime, from those contracts for doing precisely the same kind of mechanical work, and furnishing the same kind of materials and machinery, which are maritime. And my conclusion is that, if there is any reason for the distinction other than the mere fact that it exists because the courts have created it by their arbitrary decisions, it is to be found in this: That a maritime contract is defined to be one having reference to commerce or navigation. The particular element essential to give it a maritime character is direct connection with commercial transactions or navigation; and such connection is lacking in a contract to create a new ship, or, if not lacking entirely, it is remote and contingent, so that it is not perceptible at the time the contract goes into effect as a binding obligation. But whatever is done to or about an existing ship has direct reference to commerce and navigation. A ship *in esse* as a maritime subject gives a maritime character to all transactions directly connected with it. The cases are distinguishable thus: One class, founded upon contracts for the repairing and rebuilding of vessels, holds such contracts to be maritime, because they affect vessels *in esse;* and the other class, founded upon contracts for the building of proposed vessels, holds such contracts to be non-maritime, because they touch maritime subjects only by relation to proposed vessels, the future existence of which is contingent upon performance of the terms of the contract in each case."

Disposal of 300 Government Merchant Ships Recommended

WASHINGTON, D. C.

THE special committee to study the needs of the American merchant marine, recently appointed by President Coolidge, of which Chairman O'Connor of the Shipping Board is chairman, is soon to consider a preliminary report drafted by a sub-committee of experts that has been engaged on the detail work for the main committee. The sub-committee report, it is understood, recommends the disposal of approximately 2,500,000 tons of government merchant ships that have been classed as not desirable for service in the active fleet. This represents approximately 300 ships.

It is understood that the recommendations of the sub-committee contemplate that ships of this class be first offered for sale to Americans for operation. If they are not disposed of in that way offers will be considered from foreigners who would agree not to use them in competition with American ships. Finally, if they cannot be disposed of in either of these ways, they may be sold to Americans to be scrapped in the United States.

This report also recommends, as Commissioner Plummer has heretofore stated, the construction of two passenger ships for use in the North Atlantic Service of the United States Lines, to cost approximately $15,000,000 each, if the necessary authorization can be obtained from Congress.

TYPE OF DIESEL ENGINE SELECTED

The Advisory Committee appointed by Commissioner Benson of the Shipping Board to recommend the most suitable types of engines for the conversion to Diesel propulsion of Shipping Board vessels has concluded its work and submitted its final report.

Predicated on an initial conversion program comprising 12 large single-screw freighters, the committee unanimously agreed that this first step should be characterized by the utmost reliability, and accordingly recommended that only slow speed direct connected engines of proven types be used.

While recommending well tried engines for immediate installation, the committee pointed out the desirability of encouraging the development of the double-acting engine, and in view of its great advantages there is no doubt but this type will receive due consideration in the near future.

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Economy in Shipbuilding

Wide Divergence of Construction Methods and Details Furnishes Numerous Opportunities for Reduction of Costs

By Angus D. MacDonnell*

ANALYSIS of construction in the various shipyards of the country shows a wide divergence of methods adopted, indicating an opportunity for effecting economies. The following items are the result of observation over a period of years of the practical working of shipbuilding methods in North Atlantic, Delaware River, Chesapeake Bay and Pacific Coast yards. Many of these items concern that which is plainly obvious; yet this is not a justifiable reason for the continuance of expensive abuses. Again, many are items of detail, but it can be truly said that the formulating of policies and systems has become a fetish, while the so-called mere details have been relegated to the limbo of trifling non-essentials. The time is now opportune to resurrect them and give them the consideration that is commensurate with their real worth.

The supposed perfection of standardization should reduce to a minimum changes of design after work has begun in the yard. Rise of floor, turn of bilge, tumble home, flare of bow, rake of stem, sheer and camber of deck, cruiser or elliptical, single or double knuckle stern and peculiarities of forefoot can be definitely determined. However, a casual visit to many mold lofts, after the ship has been laid down, will reveal freshly painted sections of the body plan which clearly indicate a late revision of the lines. This happens no less than three or four times, even on the most ordinary bulk cargo carrier.

Temperamental Designers Costly

While the individuality of the ship is not to be sacrificed, a coherent form should be present in the mind of the designer from the beginning. Temperamental designers should give up the commercial field and confine their activities to pleasure craft where time and money are not such dominating factors. Whimsical ideas can have no other than an undesirable effect on costs, and in this regard there comes to mind a shipyard president who, in his usual brisk manner, came into the drafting room one day and placing his delicately sensitive fingers on the model of a 9,400-ton freighter inquired if the desired fining of the lines had been attended to, as per his request. He appeared happy when assured that his wishes had been respected. It is perhaps pertinent to remark that this president has since been supplanted by another.

Changes in the lines of the ship may also affect fabricated structural material, the work having progressed to this extent before the alteration was made known. Considerable designing is today being done in offices other than those of the shipbuilding corporations, and it may prove of value to point out the speed with which a ship reaches the various stages of construction in American shipyards as opposed to those foreign. When determining the principal scantlings of the ship it is the practice in older countries for the shipbuilder to interpret any controversial points in a manner favoring the builder. This practice results in the drawing, after having been submitted to the classification society for approval, coming back to the shipyard with innumerable corrections marked in red thereon. In striking contrast, the practice in American yards is to so interpret the requirements that a reasonable certainty as to their correctness can be felt. This has a beneficial result, for when a preliminary plan is sent to the classification society for approval, a copy is also sent to the yard where work begins on the construction at once. When changes do occur they are generally of a trivial nature which justifies the procedure.

One large gap is that caused by the lack of coordination existing between the technical and practical divisions. Each in its respective sphere can, by cooperation, do much toward achieving economical construction costs. In some yards the departmental heads are fully utilized by the drafting room when projecting and designing new work, with good results; but in other yards the spirit of appreciation for and tolerance toward each other is entirely lacking, and a seemingly unbridgeable gulf exists. The reason for this can generally be laid at the door of the drafting room, although a hostile attitude is frequently noticeable on the part of departmental foremen.

Cooperation Needed Between Drafting Room and Yard

A striking example of the lack of coordination existing between the drafting room and the hull construction department manifested itself in the following manner in the case of the pillaring of a ship. These pillars were of tubular section measuring two feet in diameter, and extending from the inner bottom to the deck above. The drafting room had decided that, while a doubling plate on the inner bottom was not needed to distribute bearing pressure, they would, however, fashion one after the manner of mast spring plates, which are heeled on the weather deck, and utilize doubling plates as an aid in securing watertightness of the tank below. Neither oral or verbal instruction of the procedure desired was conveyed to the construction corps who proceeded to put their own ideas into effect. Instead of first riveting the doubling plate to the bottom pillar angle with countersunk head rivets, and then flushing and calking rivet heads on the ground during assembly, the usual method of placing the doubler on the tank top plating was followed with the pillar angle being riveted through the doubler and tank top using pan head rivets. When the tank was under test, with a head of water to the load waterline, the water found its way through the riveting and into the pillar. Then the tank testers drilled an inch hole in the cap plate 20 feet above and dropped cement through to the bottom of the pillar. A one-half inch hole drilled in the pillar at varying distances above the tank top would indicate whether or not the cement had accomplished its purpose. Frequently three or four feet of cement were required before the tank was made tight. As there were a dozen such pillars per ship, this was not an inconsiderable item.

This practice was in vogue in two yards, one on the Atlantic and one on the Pacific, during which time many ships were built, and doubtless the same practice prevails now. This wasteful method continued, due to the laxity of the drafting room in not having a follow-up system with which to acquaint themselves of the manner in which work designed by them was being executed. As for the construction corps, they merely considered the operation as all in the day's work. The correct procedure, although suggested to the

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construction foremen, was not heeded, owing no doubt to the newness of the idea and the perversity of human nature. It is of significance to note that the same suggestion was acceptable to one yard of record-breaking accomplishments, and it appears on numerous occasions that the matter of successful performance is based merely on the observance of many little things, in themselves not unduly important, but in the aggregate of immense possibilities.

Opportunities for Effecting Economies When Designing Work

The importance of the drafting room cannot be minimized, yet the personnel often fails to consider economy when designing work. Only too often the draftsman finds himself dreaming hazily as to the real meaning of the trochoidal theory of wave oscillation, or else wrestling with an imaginary problem in which cavitation is seriously impairing the efficiency of the propeller. Possibly he is perplexed through having lately discovered the existence of a vital factor in certain designs—the polar moment of inertia. Under these conditions he is unable to cope successfully with such a simple problem as the plating of the shell in a manner to reduce to a minimum the rolling and furnacing of plates; or to design structural work that can easily be punched, smithed and assembled.

A case in point is that of a strake of shell plating next above the bilge, that came down about 1 inch onto the curved part of the bilge strake. This was due to the inattention of the drafting room. The strake was flat save for a set of ¼ inch due to the radius of the bilge and it was thought by the mold loft that this could be pulled into place on the ship with bolts. However, after erecting the plates, it was found impossible to pull the plate edge, necessitating taking the plates off the ship and having them "broke" in the shop with the rolls. There were at least twelve plates per ship so handled, and six ships of this type were built, making seventy-two plates on which extra work was required, thereby adding a considerable item to the cost.

The draftsman often possesses but a meager knowledge of the working of steel while the equipment and operation of the fabricating shop is practically unknown to him. This results in work being designed, that, to fabricate, requires drilling of rivet holes instead of punching; furnace work that machines should handle, chipping and burning where shearing should be done. The steel tonnage passing through this shop is frequently used as a vital index to the speed and progress of the plant. A splendid opportunity for the study of wasteful design, as well as methods, is presented in many of these shops.

Costs Reduced by Ordering Material to Neat Size

When ordering material it is often possible to reduce costs by ordering to neat size, but this advantage is frequently overlooked. On the bottom longitudinal framing of an oil tanker, there were 300 places where an inch had to be burned off the channel sections due to the fact that they had been ordered of too great length. In this same yard all brackets were ordered from mill to exact size, and at added cost, in order to save shearing them from large plates, but the channels being burned were unnoticed, being taken as a matter of course. Too much is often accepted as the inevitable, with the inquiring type of mind being as often lacking. An inquiry into the "why" of many operations during the fabricating process would reveal many instances of unnecessary labor being performed.

A costly procedure is that occasioned when the drafting room decides to "let the yard take care of it" and the mold loft similarly says "let them fix it up on the outside." The net result is an accumulation on the ship of several jobs requiring undue time and labor for completion, that a little preliminary work would have greatly lessened.

Plate Furnace Work Costly and Laborious

Draftsmen in many instances can qualify as mathematicians, and although geometry is but a small branch of this science, the application of the principles of geometry, when designing odd-shaped structures, is very often poorly executed. Here indeed is room for assistance being rendered by a practical shipbuilder skilled in the development of surfaces in all its varied phases. Such a person, versed as he is in the art of cylindrical, radial and triangular expansions, can materially aid in the economical designing of this work. Plate furnace work is easily the bane of the practical shipbuilder's existence, being at once skilful, laborious and costly. The loftsman, fitter, furnaceman, driller and bolter, all find it difficult work, and it should be avoided wherever possible. The lines as originated by the drafting room usually determine the amount of this work and frequently a minor change to the design would avoid furnace work. The following structure often needs simplification: shell, inner-bottoms, ore-carrier side tanks, topside ballast tanks, tank margins, single and twin screw bossing, stringers and keelsons, feed and filter tanks, sanitary, gravity and fresh water tanks.

Attempts on the part of foremen to cooperate with the drafting room are at times rebuffed because of a display of technical knowledge by the latter. In observing the excessive flare of the bow of a ship being laid down, the foreman's well-trained eye perceived that the transverse shape coupled with the backset produced furnace work on the shell plates. In referring same to the drafting room he was nearly overwhelmed with the explanation that the design was due to the requirements of reserve buoyancy. Again, when objecting to a proposed design of hatch coamings because of the incapacity of the equipment of the shop to handle the plates without heating same, and offering an equivalent substitute design, he was told that the required section modulus demanded the job as designed. This time the well-intentioned practical shipbuilder capitulated completely. Although both "reserve buoyancy" and "section modulus" have a place in shipbuilding, their purpose is not for the embarrassment of practical men, nor for use when desirous of covering up faulty design. A good tactician would not intimidate cohorts, especially when no worthy gain is possible, and the successful executive is, in no small measure, an adept in diplomacy.

Adding to hull construction costs is the practice of the yard corps to determine details of construction based on what they believe are strength requirements to the solution of which is brought their knowledge of forces. The yard corps as practical shipbuilders are able men and can execute orders as contained in plans and specifications to a nicety, but the field of basic design is outside their province and they should not be expected to settle questions in this realm. Nor are they generally expected to settle such matters, but due to the tendency of the drafting room to become lax on items of detail the yard corps take it upon themselves to act.

Unnecessary Refinements

A sample of this was shown by the practice in one large yard of erecting intercostal girders in the cellular double bottom. The auxiliary nature of these girders was either unknown or overlooked in an attempt to get all the strength possible therefrom. The edges of these plates were planed to secure metal to metal contact with the floors. For erection in the ship it was necessary to use turnbuckles to spread the adjacent floors, the fit was so close. Due to inaccuracies it was found that every four intercostals installed caused the floors to creep noticeably. In order to leave the sixth floor in the proper place it was advisable to scrap the fifth intercostal plate and lift a new one, which was done. While in this practice an advantage was gained during the sagging of the ship in a seaway, causing compression, it was quickly lost when the ship changed to a hogging condition, setting up tension.

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Contrast the foregoing elaborate method with that of other yards that merely cut the intercostal plates ½ inch short of each floor, thus allowing the rivets connecting to floors being stressed when the floors are subject to tripping, with no trouble being encountered when putting in place in the ship. Not the least of the evil effects of these conflicting practices is that the men actively engaged in same become steeped in wrong methods which they learn to believe are rigid requirements. Shipbuilders, being of rather migratory habits, carry these practices throughout the country. Meeting an Eastern shipbuilder in a West Coast yard, the writer was told of the unfavorable practices that had existed before our friend's advent, which he had corrected. Among them was the one cutting intercostals short, which he quickly had changed to secure a tight fit. Coming from a yard that considered tight fits unnecessary the inconsistency of the situation was ludicrously apparent.

Similar to the above is the practice in certain yards of fitting the vertical keel to secure metal to metal contact of plates. The top and bottom edges are planed to bear firmly against the rider plate and flat keel plate. Other yards deem planing of edges unnecessary and simply shear vertical keel plates ½ inch slack at top and bottom. With the advances made many years ago in structural mechanics, the decline of the bridge foreman began which ended in his total eclipse in so far as his being purely a bridge designer was concerned. It is now high time that the same thing occurred in shipbuilding. One thing against having practical men design work unaided is the fact that the job is generally many times stronger than required, which results not only in a considerably increased cost but also serves to keep the matter from coming to light, owing to the job never failing from weakness of members.

Mechanics often display initiative and become a law to themselves usurping the drafting room prerogatives of changing minor structural features. This abuse continues unabated due to the practice of hull inspection by the owners' representative reposing generally in the hands of an operating engineer, who is an engineer rather than a shipbuilder; or a practical iron worker skilled in the iron-working trades but unable to read a plan. The classification society's surveyor, while offering considerable aid to the various shipyards, is not a continual meddler, rarely interfering with the interior management of yard affairs. An instance of this practice was shown in one yard that desired to work into the ship yard stock of varying lengths. On deck beams an 8-foot backing-piece was used at butts when one 3 feet long would have been ample. Then again pillars in the forecastle under the windlass with a four rivet connection to the deck beam at the top had a 36-inch long bracket with a ten rivet connection at the bottom.

The existing practice concerning construction openings offers another illustration of divergent methods. To allow ready access to the various holds and compartments, which are not supplied with convenient permanent openings some yards cut small openings in the bulkhead plating which are suitably patched previous to tank testing or delivery. Men employed using pneumatic tools can carry the hose through these openings thus requiring fewer manifolds, and the other crafts have instant communication as well, whereas entry by means of ladders down the regular hatches causes no little inconvenience and expense. Although, as stated, some yards do this continually, other yards consider such a practice in the light of a rash act.

NAVAL VS. MERCHANT WORK

The construction of naval craft alongside merchant work is not conducive to economy in so far as the latter is concerned. By virtue of its needs, a naval vessel must be of the highest class, with cost a secondary item. This does not necessarily apply to merchant ships and to arrange conditions to suit the best interests of all concerned the classification society came into being. The superintending naval constructors, with their able staffs of warrant officers and civilian inspectors, are well able to, and do, secure the highest grade of work possible. This has a most stimulating effect on the morale of shipbuilders and affects both the office and yard forces. But this same spirit may prove a handicap in the construction of merchant work.

The superdreadnought whose hull is expected to withstand the reaction of a broadside of gunfire should not be considered in the same light as a tramp ship that will doubtless sail the seas unmolested. Perhaps it is a submarine, that aside from a considerable hydrostatic pressure when submerged, may be reasonably expected to withstand the pressure transmitted through the water by a depth bomb. Such a craft should not be likened to a sound steamer, a coaster or an insular liner.

Nor should a destroyer whose great speed demands a generating plant of immense size, necessitating the reduction of hull weights to a minimum, consistent with strength, be considered the same as a ferryboat, a car float, or a lighter that may never leave its home port.

Special emphasis should be brought to bear on the minds of employees that the refinements that naval craft demand are to be omitted on merchant work. Mechanics trained to meet exacting requirements find it difficult to adjust themselves readily to work of a less rigorous nature. Precedent forms quite a basis in the design of new work and an instance of an aggravated case presented itself in one drafting room when the plans of a battleship were referred to during the designing of a collier.

The simplicity of merchant ships when compared with naval vessels should not serve as a deterrent to men desirous of becoming high grade shipbuilders. While a naval vessel, when viewed from an engineering standpoint, represents the zenith of achievement, it does not offer the same opportunity to the individual shipbuilder as does a merchant ship. The naval vessel, being such a huge problem, requires the services of a great many specialists, and even they are held in check by forces beyond their control that tend to destroy any initiative they may possess.

The same cannot be said of merchant ships. While the classification societies do not accept any untried or unproved ideas, their rules and regulations are sufficiently elastic to encourage individual initiative in the development of the basic principles from which their rules are promulgated. A sound business today must be built on a cornerstone of profits, preferably competitive profits, and the merchant vessel offers not only a chance for the shipbuilder to develop his esthetic sense and inventive genius but to blend both harmoniously with his business acumen. The naval vessel denies him the same opportunity.

MOLD LOFT PRACTICE

The mold loft today is a firmly intrenched department in all up-to-date yards having made secure its place by virtue of its filling a distinctive need, that being a demand for faster and more economical hull construction. The work of this department has long since passed the experimental stage as several modern yards in the Eastern shipbuilding centers can attest. However, at the present time merchant ships are under construction from whose hulls shell plating is being lifted by shipfitters on the rather specious grounds that it can be thus done cheaper than shell produced by the mold loft can be "regulated." This is purely a case of craft bias or partisanship, indulged in by those in command, that only too often manifests itself throughout the various departments. The nurturing of craft pride is laudable when kept within proper constraints, but there comes a point where the real executive—he who visualizes the greater interests of the corporation as opposed to that of any department—must act in a broader sense to achieve the best results.

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PUNCHING OF PLATES

The practice relative to the punching of plates also varies greatly. The back-marking of shell plates was made a rather elaborate process in one yard. This process requires certain holes to be punched from one side of the plate and the remainder punched from the opposite side. The explanation given was the need of punching away from faying surfaces to avoid burr and also to secure conical holes for swelled-neck rivets. In this yard the shipfitters marked holes on both sides of the plate while in another yard the plate-puncher reversed the holes to be punched over when the plate was on the sling. A few miles away two other yards completely ignored the necessity of such procedure and merely marked the plate on one side and punched all holes from that side.

SHEARING AND PLANING OF PLATE EDGES

The shearing and planing of plate edges for calking also show conflicting methods. One yard shears away from faying surfaces and planes the edge to a 90-degree bevel; another shears and planes to a 60-degree bevel, while still another merely shears, and neither watches the burr nor planes the edge. However, the latter yard made special efforts to keep their shears in good working condition.

The practice regarding scarfing of plate laps is also interesting. One yard scarfs almost to neat size using a square cutting tool while another allows a small clearance and uses a curved tool. The former desires a neat fit which often makes chipping-out of scarfs on the ship necessary during construction, while the latter yard has no such trouble, suffering no delay or added expense.

COUNTERSINKING OF BULKHEADS

Countersinking of bulkheads is another item showing different methods. The ease with which snap points are driven caused one yard to so rivet their hose-tested bulkheads on freighters, thereby avoiding countersinking as well. A nearby yard countersunk all rivets below the load waterline and used snap points above, while another exacting yard countersunk all holes. Countersinking is not a negligible item, being at best a troublesome piece of work not to be lightly considered. Although holes may be countersunk in the fabricating shop it is generally necessary to re-countersink them again on the ship because of irregularities that develop during erection.

While even during the past generation rapid strides forward have been made in American shipbuilding methods this progress has only accentuated the importance of riveting and its counterpart, that of bolting. An accumulation of standard and reference plans has simplified drafting room practice, universal work and increased knowledge have aided the mold loft, while one man and multiple punches, burning and welding as well as other improved machinery have assisted in the fabrication process; but the bolting and riveting, even under improved conditions, remain a problem of no small moment. It is therefore the more surprising to find riveting looked upon so lightly, which results in nearly every hull having what amounts to an altogether too large percentage of excess riveting.

RIVETING

Although of an elementary nature it may prove of value to enumerate the various movements necessary to complete the work in which a rivet is the unit. The location of the rivet in the hull fixed, the draftsman determines the length and notes the diameter of shank and type of head required. This information is supplied to the purchasing agent who then orders same from a manufacturer, or it may be made in the yard. Next the storekeeper is the custodian until such time as the holder-on arrives with a requisition from his foreman. The rivet is then taken to the rivet forge where it is heated by the heater, carried to and inserted in the hole by the passer, held in place by the holder-on, and driven home by the riveter. It is then counted for payment by the piece-work counter, who is followed by the builders' tester. The owners' representative next tests the rivet, and finally the classification society's surveyor tests it. Any one of these three testers may find the rivet defective and order it hardened or removed. If required to be watertight, it may be necessary to calk same, although this practice is frowned on by surveyors.

The following operations are involved in making the rivet hole. The location is first marked on a wood or paper templet by a loftsman and then duplicated on the steel plate or shape by a shipfitter. Next the hole is punched by a puncher and then, if it is watertight work, it is countersunk by another machine hand. To assemble, it is bolted in place by a bolter-up and reamed out by a reamer, who perhaps re-countersinks it, too. The many operations required should in themselves be an incentive to cut down excess riveting to a minimum, but generally the reverse is true and the hull is often literally peppered with rivets. While objections by inspectors to the riveting being too widely spaced on watertight work are at times raised, complaint about its being too closely spaced is seldom heard. Structural compensation for too closely spaced holes is rarely demanded, all that is seemingly necessary is that the holes be numerous and fair, with the rivet heads and points properly shaped.

The following cases have been observed: In one ship a tier of beams had brackets to frames with 11 excess rivets in one leg. Several duplicates of this ship were built. Of many other brackets requiring equal legs the worst case had 8 rivets against 2. A small watertight floor had 11 excess rivets in the bounding angle. The garboard strake of the shell on an oil tanker had 12 excess rivets at each bulkhead. As every rivet is, potentially, a defective rivet and as an old established yard estimated the cost of cutting-out and replacing a rivet at 40 cents, the seriousness of excess riveting is evident. The custom that executives have of thinking and talking about rivets in terms of number of rivets driven per gang hour, of total number of rivets driven per week, and of the hundreds of thousands or perhaps a few million rivets per ship, has had the effect of minimizing the importance of the unit—*one rivet*.

A REMEDY FOR EXCESS RIVETING

A remedy suggested to help reduce excess riveting is to have the drafting room, working in collaboration with the construction department, supply detailed plans of riveting. This idea is not new and although these plans are often drawn they are usually discarded by the outside departments due to their being impracticable. There is need of closer cooperation on this matter for while the drafting room is deficient in a knowledge of universal work in the mold loft, and of shop practice in the fabricating shop, the outside departments are just as deficient in a knowledge of the shearing and bearing values of rivets. A union of the technical with the practical would effect improvement.

The smug self-satisfaction that many draftsmen feel, because of their ability to draw up useless riveting details, is only increased by the desire of construction foremen to maintain harmony, and who thus refrain from objecting to the drafting of these plans. The motive, however worthy, causes abuses in other ways, and here indeed is perhaps justification for the attitude assumed by a former West Coast shipyard manager of more than local fame. On returning from a business trip to the East, he inquired of an assistant how things had fared during his absence. The assistant, in an effort to satisfy the turbulent manager, said: "Things went fine, we had perfect harmony," to which the famous one replied: "Harmony! Harmony be d——! We don't want harmony."

Objection cannot be registered that these occurrences were due to abnormal conditions. On the contrary the cases

(*Continued on page* 472)

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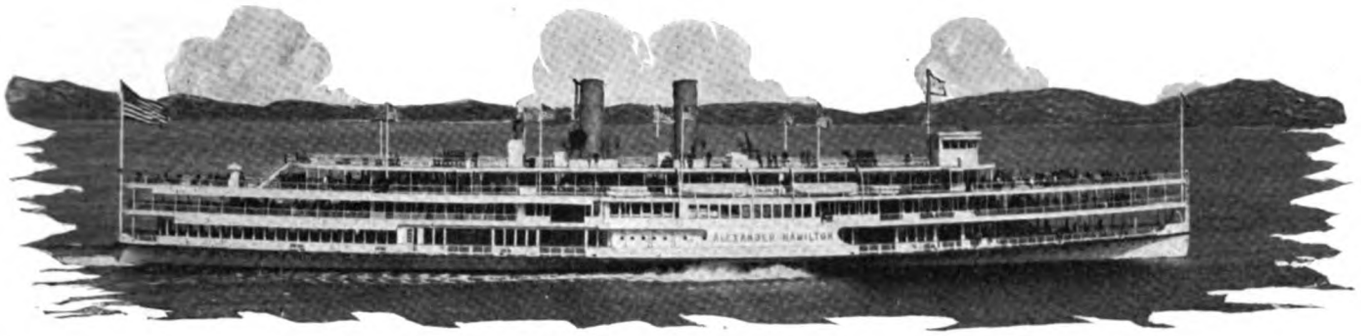


New Hudson River Day Line Steamer "Alexander Hamilton"

S. S. Alexander Hamilton Joins Hudson River Fleet

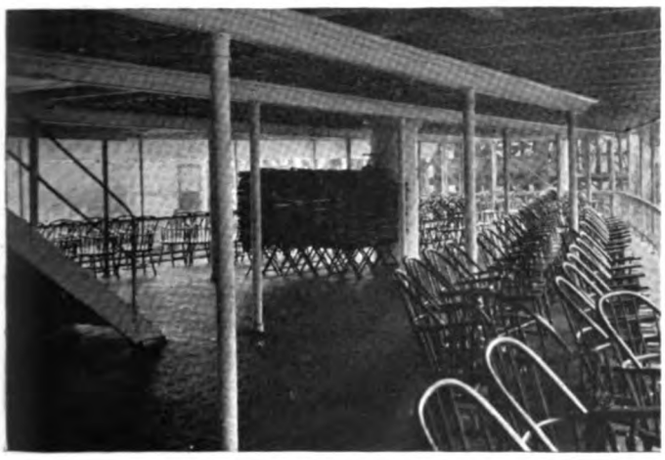
New Oil-Burning Steamer Built by Bethlehem Shipbuilding Corporation for Hudson River Day Line Carries Over 4,000 Passengers

THE most recent addition to the fleet of the Hudson River Day Line, the steamer *Alexander Hamilton,* was placed in commission early in June and is giving very satisfactory service, fully up to the exacting requirements of her owners.

Designed by J. W. Millard & Bro. of New York and built by the Bethlehem Shipbuilding Corporation at their Sparrow's Point plant, the *Hamilton,* while showing no radical departures from the other modern Day Line boats, is a notable example of the successful working out of a design

Shade Deck, Looking Forward

Promenade Deck, Looking Aft



After End of Saloon Deck

Dining Saloon

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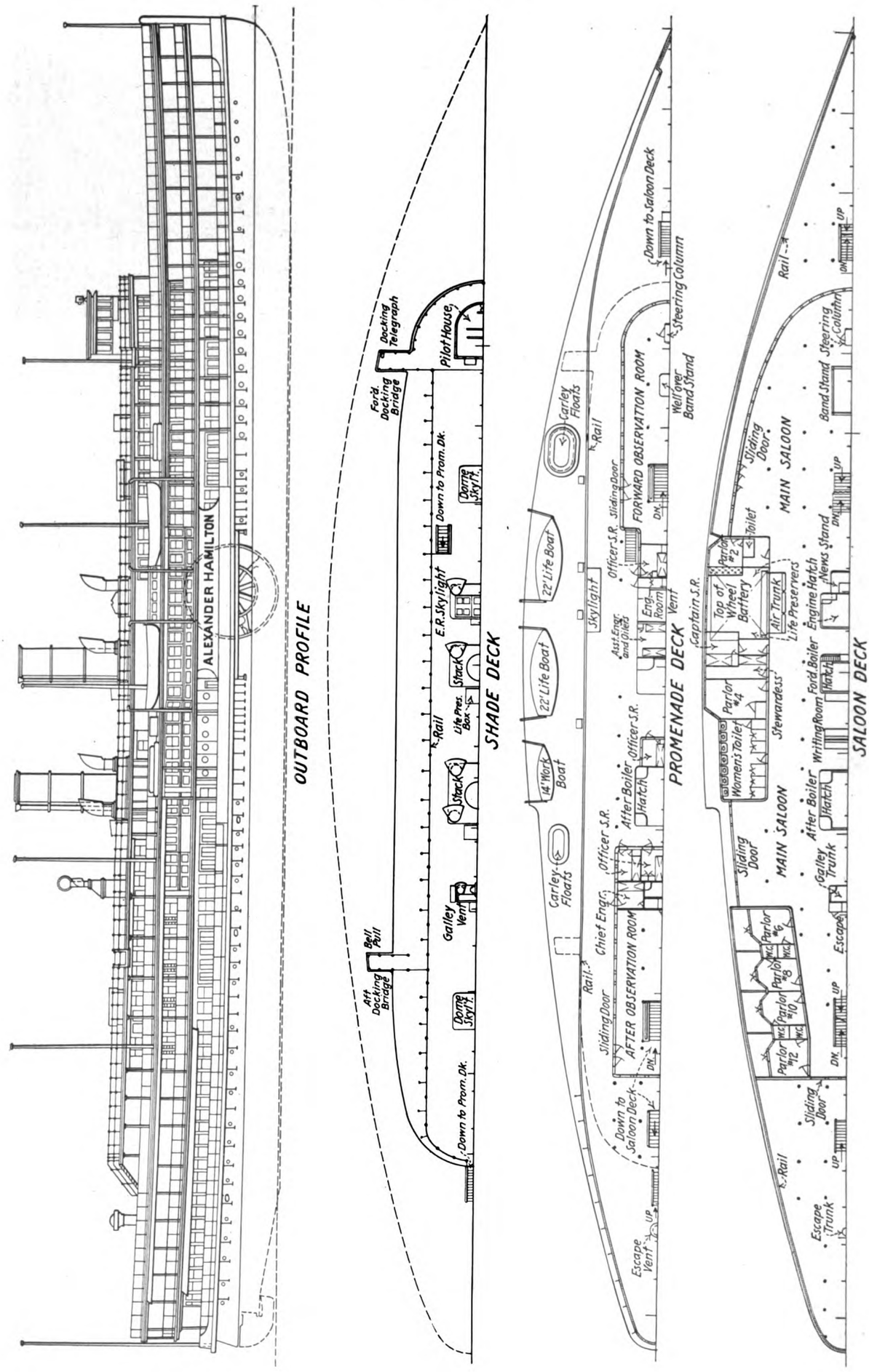

S. S. Alexander Hamilton: Profile and Deck Plans

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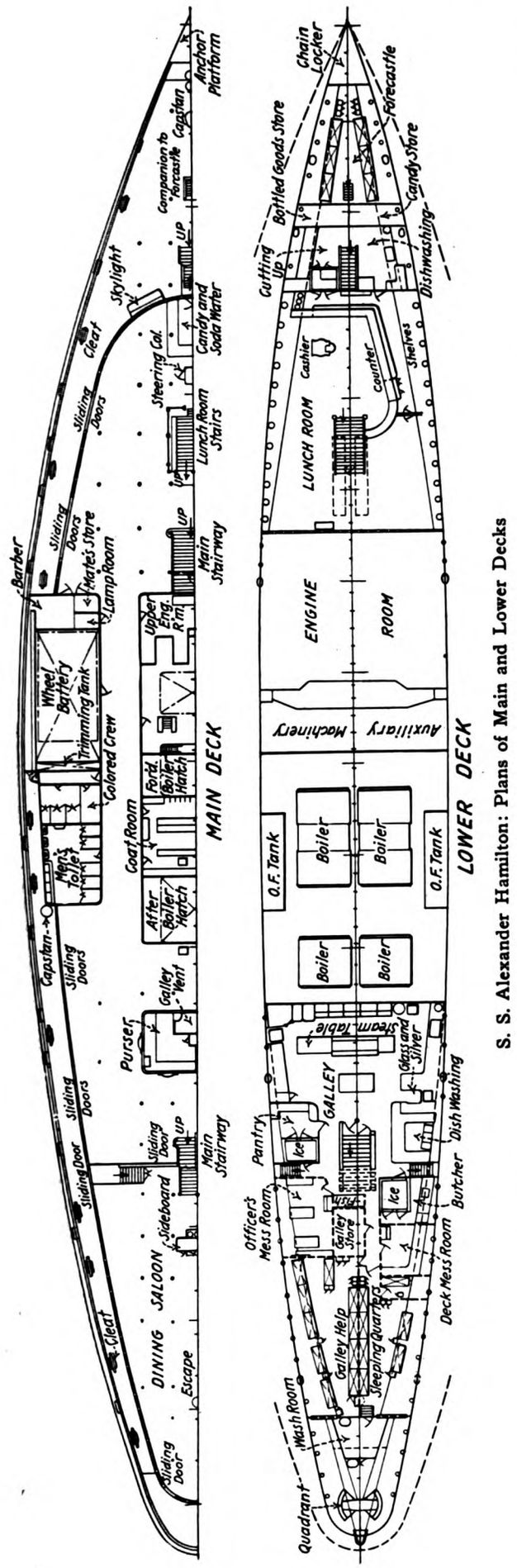

S. S. Alexander Hamilton: Plans of Main and Lower Decks

Main Saloon

to meet very special and trying conditions, and embodies the latest ideas and developments in steamboat construction.

The principal dimensions of the vessel are as follows:

Length over all	348 feet 0 inches
Length between perpendiculars	334 feet 6 inches
Beam, molded	42 feet 0 inches
Beam, over guards	78 feet 0 inches
Depth, molded	13 feet 8 inches
Depth, main to saloon decks	9 feet 6 inches
Depth, saloon to promenade decks	8 feet 0 inches
Load draft	8 feet 1 inch
Licensed passenger capacity	4,050

HULL CONSTRUCTION

The hull is constructed entirely of steel with transverse frames and joggled shell plating. The machinery casings are of steel and the joiner decks are supported by longitudinal steel girders, resting on steel stanchions. The midship section clearly shows the general type of construction followed by which great strength and stiffness is obtained with a minimum of weight. The construction details have all been most carefully worked out. Among these may be noted the slight "tumble home" of the side plating, introduced to simplify and strengthen the riveting in the way of the wheel batteries, and the small castings, fitted at the joiner decks, to make the metal stanchions continuous. Great care was exercised throughout the entire construction to make the vessel the finest in the fleet.

There are two built-in fuel oil tanks abreast of the boilers,

Main Deck, Looking Aft

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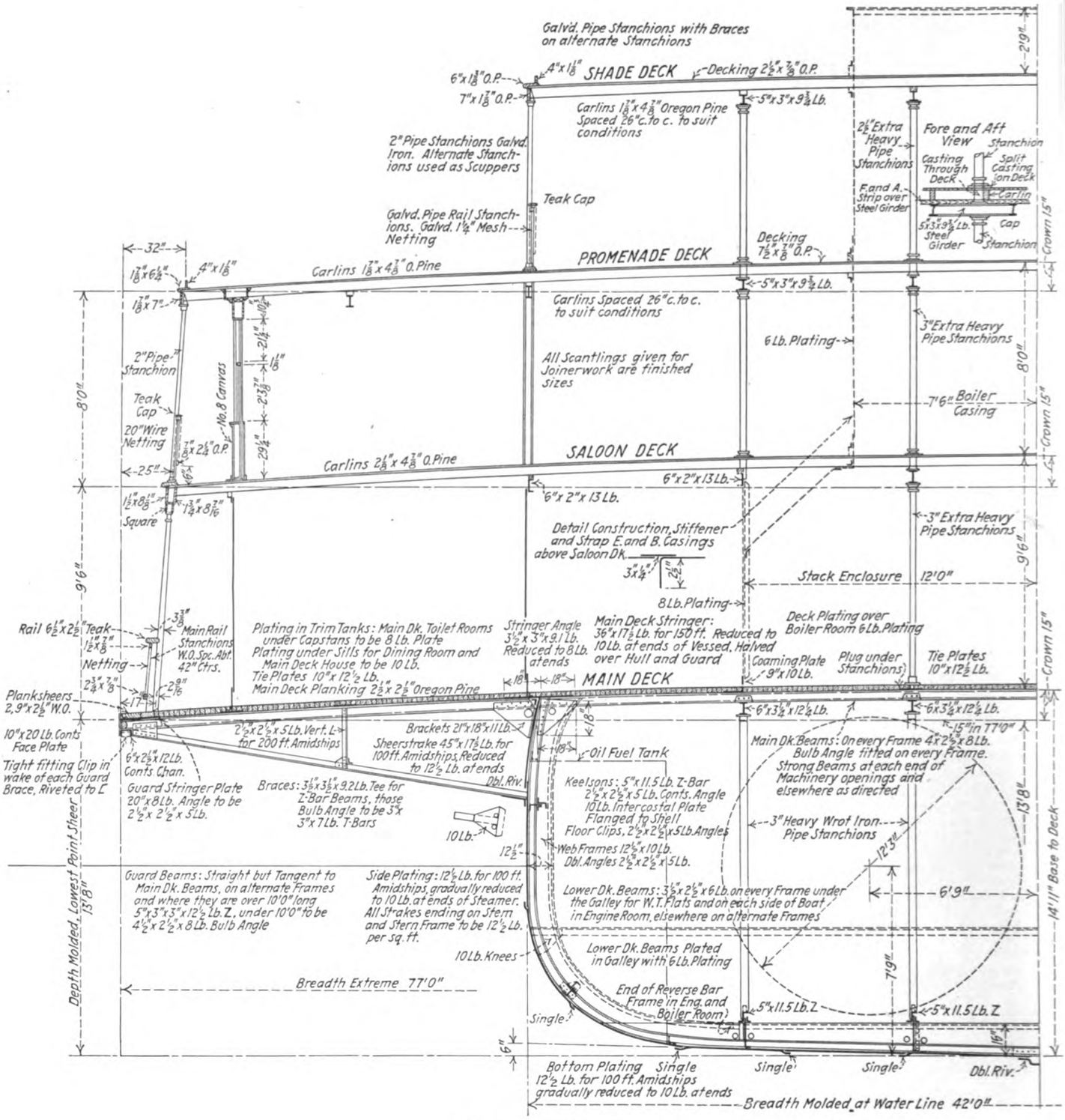
Galvd. Pipe Stanchions with Braces on alternate Stanchions
SHADE DECK
Decking 2½"x⅞" O.P.
Carlins 1⅞"x4⅜" Oregon Pine Spaced 26" c.to c. to suit conditions
5"x3"x9¾ Lb.
2½" Extra Heavy Pipe Stanchions
Fore and Aft View
Stanchion
Split Casting on Deck
Casting Through Deck
Carlin
F. and A. Strip over Steel Girder
Cap
Stanchion
2" Pipe Stanchions Galvd. Iron. Alternate Stanchions used as Scuppers
Teak Cap
Galvd. Pipe Rail Stanchions. Galvd. 1¼" Mesh Netting
PROMENADE DECK
Decking 7½"x⅞" O.P.
Carlins 1⅞"x4⅜" O.Pine
Carlins Spaced 26" c. to c. to suit conditions
All Scantlings given for Joinerwork are finished Sizes
6 Lb. Plating
3" Extra Heavy Pipe Stanchions
7'6" Boiler Casing
2" Pipe Stanchion
Teak Cap
20" Wire Netting
No. 8 Canvas
SALOON DECK
Carlins 2½"x4⅜" O.Pine
6"x2"x13 Lb.
Detail Construction, Stiffener and Strap E. and B. Casings above Saloon Dk.
3" Extra Heavy Pipe Stanchions
Stack Enclosure 12'0"
8 Lb. Plating
Rail 6½"x2½" Teak
Main Rail Stanchions W.O. Spc. Abt. 42" Ctrs.
Netting
Plating in Trim Tanks: Main Dk. Toilet Rooms under Capstans to be 8 Lb. Plate
Plating under Sills for Dining Room and Main Deck House to be 10 Lb.
Tie Plates 10"x12½ Lb.
Main Deck Planking 2½"x2½" Oregon Pine
Stringer Angle 3½"x3"x9.1 Lb. Reduced to 8 Lb. at ends
Main Deck Stringer: 36"x17½ Lb. for 150 ft. Reduced to 10 Lb. at ends of Vessel. Halved over Hull and Guard
Deck Plating over Boiler Room 6 Lb. Plating
Coaming Plate 9"x10 Lb.
Plug under Stanchions
Tie Plates 10"x12½ Lb.
MAIN DECK
Plank sheers 2,9"x2½" W.O.
10"x20 Lb. Conts Face Plate
Tight fitting Clip in wake of each Guard Brace, Riveted to C
6"x2½"x12 Lb. Conts. Chan.
Guard Stringer Plate 20"x8 Lb. Angle to be 2½"x2½"x5 Lb.
2½"x2½"x5 Lb. Vert. L for 200 ft. Amidships
Brackets 21"x18"x11 Lb.
Sheerstrake 45"x17½ Lb. for 100 ft. Amidships, Reduced to 12½ Lb. at ends
Braces: 3½"x3½"x9.2 Lb. Tee for Z-Bar Beams, those Bulb Angle to be 3"x3"x7 Lb. T-Bars
Dbl. Riv.
6"x3¾"x12¼ Lb.
Main Dk. Beams: On every Frame 4"x2½"x8 Lb. Bulb Angle fitted on every Frame. Strong Beams at each end of Machinery openings and elsewhere as directed
Oil Fuel Tank
Keelsons: 5"x11.5 Lb. Z-Bar 2½"x2½"x5 Lb. Conts. Angle 10 Lb. Intercostal Plate Flanged to Shell
Floor Clips, 2½"x2½"x5 Lb. Angles
Web Frames 12½"x10 Lb. Dbl. Angles 2½"x2½"x5 Lb.
3" Heavy Wrot Iron Pipe Stanchions
Guard Beams: Straight but Tangent to Main Dk. Beams, on alternate Frames and where they are over 10'0" long 5"x3"x3"x12½ Lb. Z, under 10'0" to be 4½"x2½"x8 Lb. Bulb Angle
Side Plating: 12½ Lb. for 100 ft. Amidships, gradually reduced to 10 Lb. at ends of Steamer. All Strakes ending on Stem and Stern Frame to be 12½ Lb. per sq. ft.
Lower Dk. Beams: 3½"x2½"x6 Lb. on every Frame under the Galley for W.T. Flats and on each side of Boat in Engine Room, elsewhere on alternate Frames
Lower Dk. Beams Plated in Galley with 6 Lb. Plating
10 Lb. Knees
End of Reverse Bar Frame in Eng. and Boiler Room
5"x11.5 Lb. Z
Breadth Extreme 77'0"
Depth Moulded, Lowest Point Sheer
Bottom Plating 12½ Lb. for 100 ft. Amidships gradually reduced to 10 Lb. at ends
Single
Dbl. Riv.
Breadth Moulded at Water Line 42'0"
Crown 15"
8'0"
9'6"
13'8"
14'11" Base to Deck

Midship Section

and a trimming tank of about 30 tons' capacity aft of each paddle wheel casing. These latter tanks do away with the use of ballast barrels and trucks, an objectionable feature on the older steamboats.

The joiner decks, inside and outside of the houses, are canvas covered, and also the sides of the houses, below the windows. Haskellite has been used for all joiner bulkheads, being veneered to match the trim of the various spaces. The dining saloon is finished in mahogany as are also the private day cabins, or parlors, on the saloon deck. On the casings and bulkheads of this deck are a series of fine mural paintings depicting incidents in the life of Alexander Hamilton.

Ample toilets and wash rooms are fitted up on the main and saloon decks, and each parlor has a private toilet connected. All the plumbing fittings were furnished by the A. B. Sands & Sons Company.

Propelling Machinery

The propelling machinery consists of an inclined, triple expansion engine having cylinders 36½ inches, 57 inches and 85 inches in diameter by 72 inches stroke, driving feathering paddle wheels 22 feet 6 inches in diameter. Each wheel has 9 floats of steel, 12 feet 6 inches long, 3 feet 9 inches wide and 1⅛ inches in thickness. The wheel shafts

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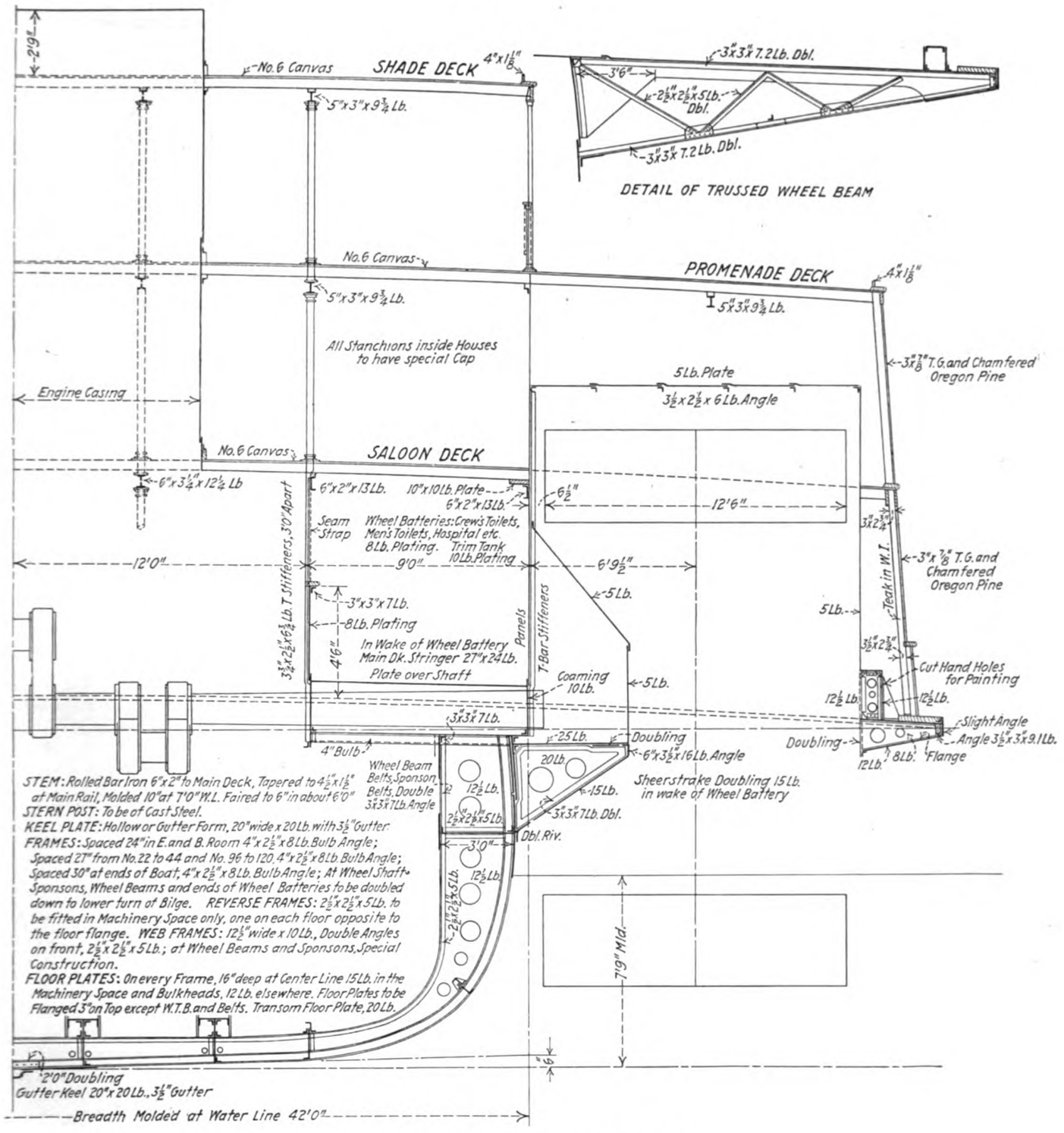
SHADE DECK
No.6 Canvas
PROMENADE DECK
SALOON DECK
DETAIL OF TRUSSED WHEEL BEAM
All Stanchions inside Houses to have special Cap
Engine Casing
5Lb. Plate
Wheel Batteries: Crew's Toilets, Men's Toilets, Hospital etc. 8Lb. Plating. Trim Tank 10Lb. Plating
In Wake of Wheel Battery Main Dk. Stringer 27"x24Lb. Plate over Shaft
Coaming 10Lb.
Wheel Beam Belts, Sponson Belts, Double 3½"x3"x7Lb. Angle
Sheerstrake Doubling 15Lb. in wake of Wheel Battery
Teak in W.T.
Cut Hand Holes for Painting
Slight Angle
Doubling
Flange
Dbl. Riv.
7'9" Mld
2'0" Doubling
Gutter Keel 20"x20Lb., 3½" Gutter
Breadth Molded at Water Line 42'0"
STEM: Rolled Bar Iron 6"x2" to Main Deck, Tapered to 4½"x1½" at Main Rail, Molded 10" at 1'0" W.L. Faired to 6" in about 6'0"
STERN POST: To be of Cast Steel.
KEEL PLATE: Hollow or Gutter Form, 20" wide x 20Lb. with 3½" Gutter
FRAMES: Spaced 24" in E. and B. Room 4"x2½"x8Lb. Bulb Angle; Spaced 27" from No.22 to 44 and No. 96 to 120. 4"x2½"x8Lb. Bulb Angle; Spaced 30" at ends of Boat, 4"x2½"x8Lb. Bulb Angle; At Wheel Shaft Sponsons, Wheel Beams and ends of Wheel Batteries to be doubled down to lower turn of Bilge. REVERSE FRAMES: 2½"x2½"x5Lb. to be fitted in Machinery Space only, one on each floor opposite to the floor flange. WEB FRAMES: 12½" wide x 10Lb., Double Angles on front, 2½"x2½"x5Lb.; at Wheel Beams and Sponsons, Special Construction.
FLOOR PLATES: On every Frame, 16" deep at Center Line 15Lb. in the Machinery Space and Bulkheads, 12Lb. elsewhere. Floor Plates to be Flanged 3" on Top except W.T.B. and Belts. Transom Floor Plate, 20Lb.

Section Through Center Line of Shaft

are hollow, 17 inches outside diameter. The valve gear is of the link type. Lockwood & Carlisle piston packing is used, and a special shoe is fitted under each piston to carry its weight and avoid unequal wear of the cylinder bore.

There is a single cylindrical condenser, 6 feet 6 inches in diameter and 11 feet long, having 5,750 square feet of cooling surface.

There are 2 single end and 2 double end Scotch boilers, the former, 11 feet 3 inches and the latter 22 feet long, with a common diameter of 12 feet. Each single end boiler has two and each double end four 42-inch Morison furnaces. The single end boilers have 276 common and 64 stay tubes, all 2½ inches outside diameter, and the double end, twice this number. The total heating surface is 12,600 square feet, and the working pressure, 180 pounds per square inch.

The boilers are fitted for burning fuel oil, the Peabody system of burners and heaters, etc., being installed.

AUXILIARIES

The following auxiliaries are fitted:

Circulating pump, centrifugal, 14 inches, Morris Machine Works, reciprocating engine.

Air pump, twin beam, 12 inches by 25 inches by 18 inches, Worthington.

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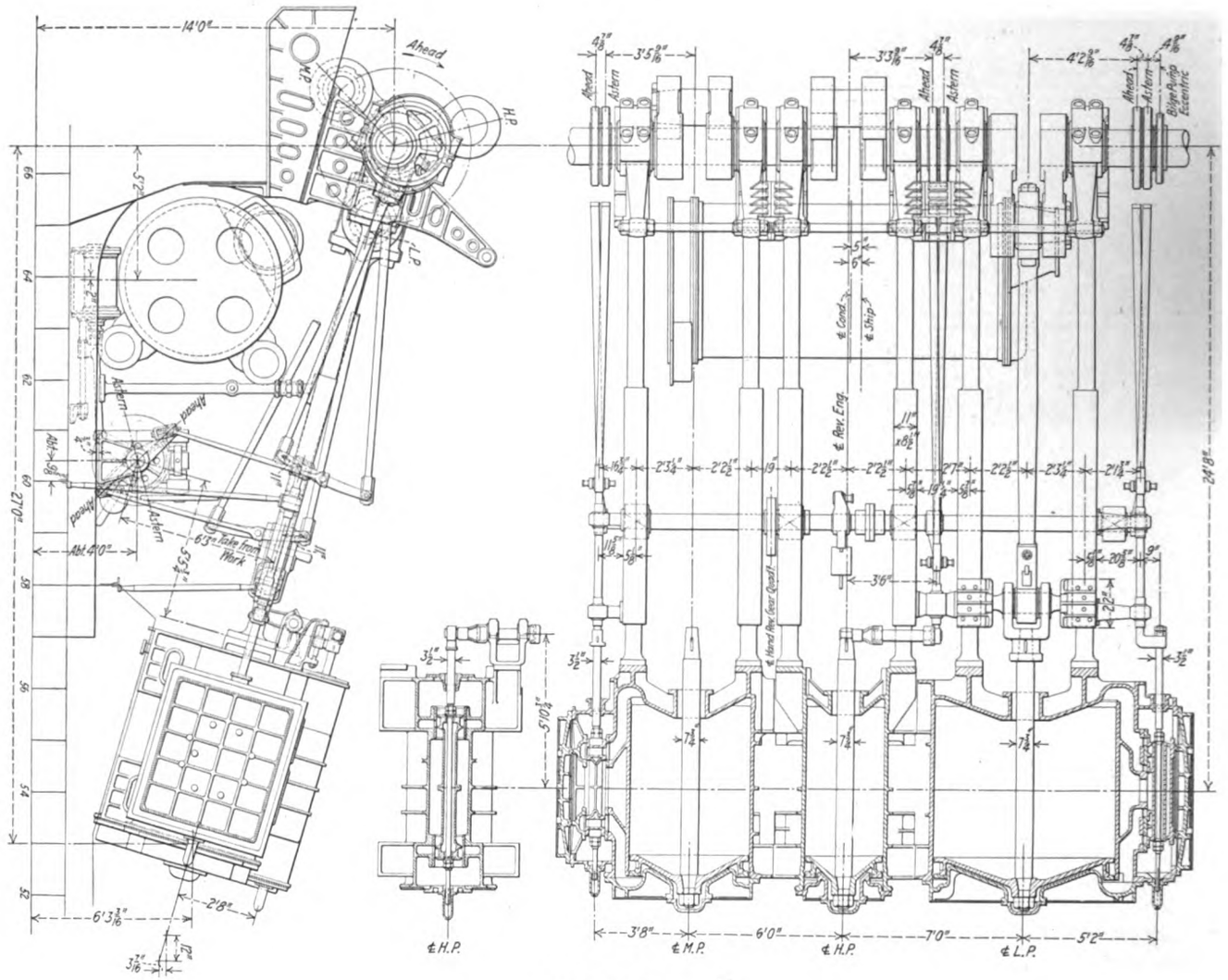
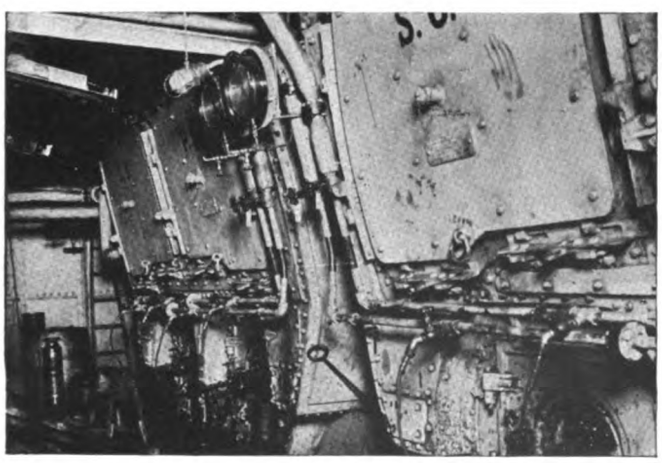
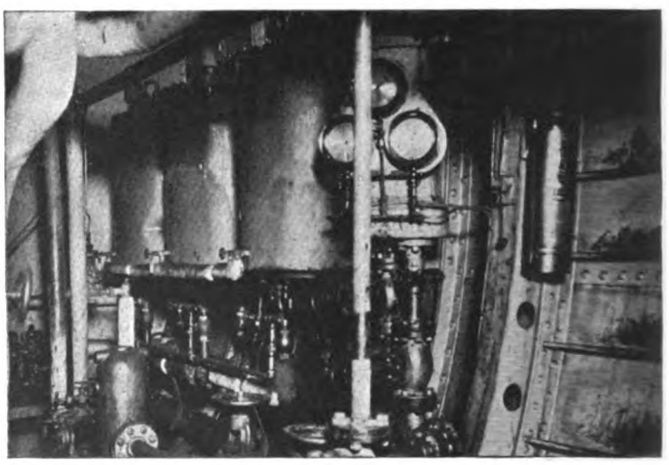


Main Engine

Main feed pump, Horizontal compound, 12 inches and 18 inches, steam, 10 inches, water, by 18 inches, Worthington.
Auxiliary feed pump, vertical duplex, 12 inches by 8½ inches by 12 inches, Worthington.
Donkey pump, vertical duplex, 12 inches by 10½ inches by 12 inches, Worthington.
Sanitary pump, horizontal simplex, 10 inches by 10 inches by 18 inches, Worthington.
Bilge pump, horizontal simplex, 10 inches by 10 inches by 18 inches. This pump is made by Worthington Pump & Mach. Co.
Fresh water pumps (2), horizontal simplex, 8 inches by 8 inches by 12 inches, Worthington.
Trim pump, centrifugal, Worthington, driven by a Terry turbine.
Ice water pump, duplex, 4½ inches by 2¾ inches by 4 inches, Worthington.
Fuel oil pumps (2), horizontal duplex, 6 inches by 4 inches by 6 inches, Deane.
Paracoil feed heater.



Boiler Room



Fuel Oil Pumps and Heaters

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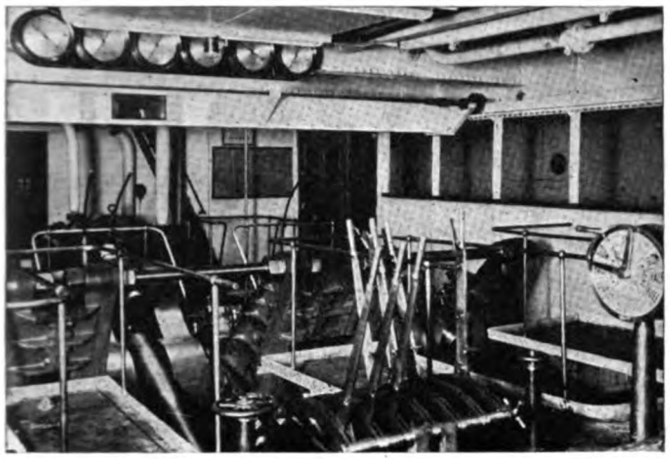

Upper Engine Room

Forced draft fans (2), Howden multivane, each driven by a Howden engine.
The electric plant consists of two 25 k.w. General Electric generators, driven by Terry turbines. There are 500 outlets and approximately 1,200 lights, and an 18-inch searchlight.

With the engines running at 40 revolutions per minute approximately 4,000 indicated horsepower is developed, giving the vessel a speed of 20.6 statute miles per hour.

Americanization Afloat*

By F. H. Haines†

THE Sea Service Bureau was established by the United States Shipping Board in 1918 to man its great fleet of some 1,500 merchant vessels with American seamen. Prior to the launching of our National merchant marine, we could not find more than 10 percent American seamen who were following the overseas trade routes under the American flag. At present we are placing approximately 90,000 men per annum at 14 ports and of this total 75 percent are Americans. In this particular district, 82 percent of the total crews on Shipping Board vessels are American citizens, while on privately owned vessels (which do not come under our service) there are only about 54 percent Americans.

If we should leave the crewing of such a fleet to private shipping masters, as was the case in the old days, the cost to the owners would be almost prohibitive, or about ten times the cost of our service. Furthermore there would be no means of eliminating the radical or other undesirable element. We find that only about 5 percent of such radicals were born under our flag, while some 90 percent are foreign extraction. These figures convince us of the desirability of manning our fleet with native born Americans.

The report of the Commissioner of Navigation for 1923 shows that there were 239,332 seamen shipped and reshipped on American vessels from all ports in the United States; 92,535 were native born Americans, 27,611 naturalized Americans and 24,736 British, which country was second in all other aliens represented.

The remedy for radicalism afloat is 100 percent Americanism which means that a definite policy must be established which will make it possible to attract more young Americans to sea.

The Shipping Board is now seriously considering the apprentice system which provides for one or more deck and engine apprentices on each ship at nominal wages. Such men after making one voyage, or in the discretion of the master or chief engineer, would be promoted to ordinary seamen or wipers as the case might be, and they would then be thoroughly able, in conjunction with our service, to take care of their future assignments by reason of satisfactory discharges from previous ships.

We reached the peak of Americanization afloat some months ago and are now slowly but surely placing our merchant naval auxiliary at the mercy of aliens, who will predominate in the near future, unless some definite action is taken which will make it possible to attract and hold the American on the seas.

Shipping activities on the high seas are fully as important to the welfare of our Nation as our means for defense, and after a long series of disastrous experiences, it has dawned upon those in responsible charge of our merchant marine activities that, if we are to succeed, our merchant ships must be as thoroughly Americanized as our ships of war.

This Americanization applies not alone to officers and crews, but to ownership, builders, insurance, banking facilities, representatives in foreign ports, superintendents and operators wherever located. We are not now dependent on aliens for any one of the functions which go to make up a thoroughly successful and efficient merchant marine. We should, therefore, declare our absolute independence of all foreign help, and what is more, put in practice at once this spirit of independence.

Those of foreign birth connected with our shipping activities, in any of its ramifications, should either declare their sincere desire to stay with us, become thoroughly American in thought and action, bear single allegiance to our flag, or get out of the country. Every other maritime nation in the world operates its merchant marine by its own people, and we must do likewise, else we must step back and supinely declare our inability to carry on our own shipping.

We criticize no other nation for thus safeguarding its own interests on the seas, nor can any other nation justly criticize us for doing the same. Present depression in the world's shipping makes it mandatory for us to look after our own interests and quit being the international "Good Samaritan" by the employment of seafarers of all other nations to the detriment of our own citizens and to the amusement of our rivals.

We are being warned almost daily by men who are in close touch with the various revolutionary agencies and groups, that we are allowing our great American complacency to close our eyes and ears to the true picture. We are actually helping them bore from within by our indifference and by following the course of least resistance.

With the dawn of the new immigration, or Johnson, bill, which became effective July 1, we have closed the gates on this hoard, but the assimilation of the vast millions of undesirables already dumped on our shores will require generations. We should now and forever stand porter at the door of American thought and true ideals and insist on loyalty and true Americanism.

*Abstract of an address delivered before Civitan Club, Baltimore, Md., on June 20.

†Manager, Sea Service Bureau, U. S. Shipping Board.

SOUTHERN PACIFIC LINER LAUNCHED.—The steamship *Bienville,* under construction at the yards of the Todd Dry Dock and Construction Corporation, Tacoma, Wash., for service between New York and New Orleans in the Southern Pacific Company Atlantic Steamship Lines (Morgan Line) fleet, was launched on July 16. The vessel is a single screw oil-burning steamer, 445 feet long overall, with deadweight of about 7,000 tons at a draft of 25 feet six inches. She is designed for a speed of 16 knots. First class passengers are accommodated in outside staterooms of extra large width on the hurricane and promenade decks, in addition to which there are six de luxe suites.

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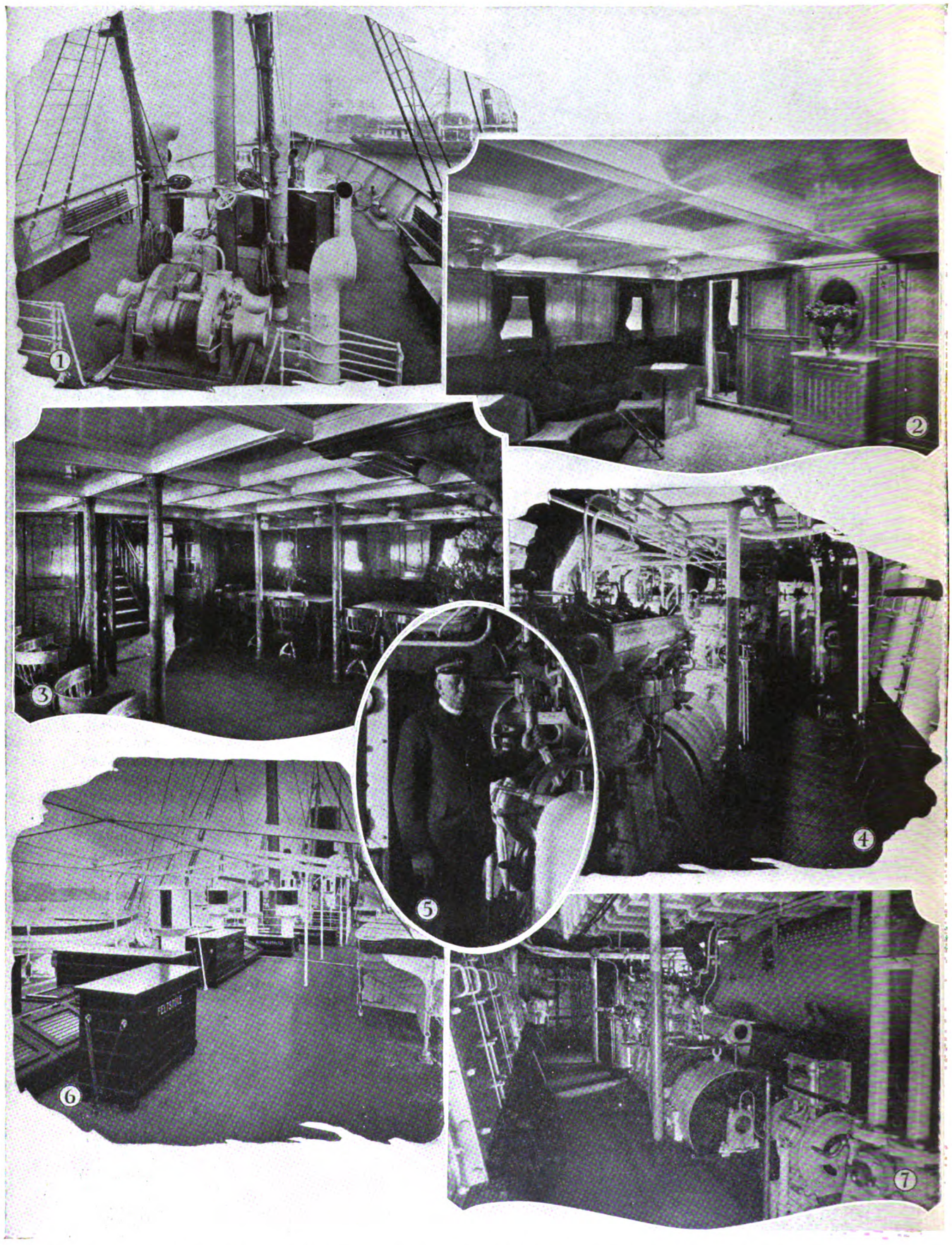

Motorship Frem: (1) Looking Forward from Boat Deck, (2) Ladies' Saloon, (3) Dining Saloon, (4) Auxiliary Engines, (5) Maneuvering Platform, (6) Boat Deck Looking Forward, (7) Engine Room

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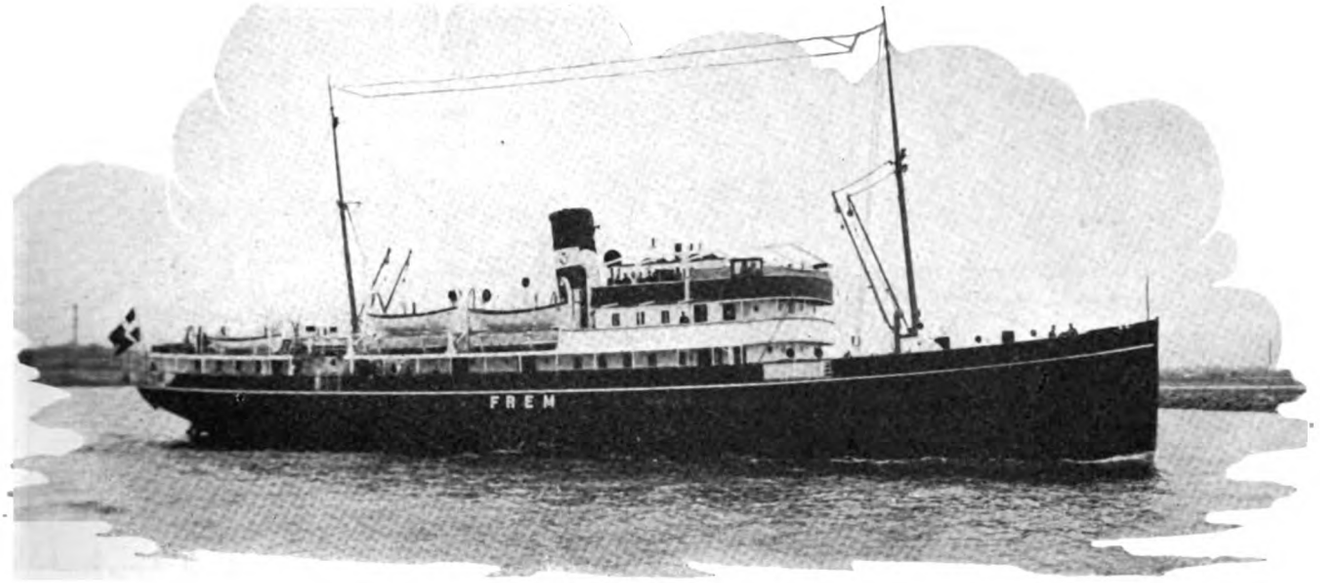

Motorship Frem on Her Trial Trip

New European Motor Passenger Vessels

Motorship Frem Built for Service Between Copenhagen and the Island of Bornholm—15-Knot Motor Liner Ordered

IN some quarters, the opinion is now held that even in cases where, owing to the relative prices of oil and coal, the motor vessel shows little financial saving, its employment is warranted in passenger craft. An instance is to be seen in the new motorship *Frem,* a small vessel built by Burmeister & Wain, Ltd., Copenhagen, Denmark, which is to ply exclusively in European waters, between Copenhagen and the Island of Bornholm. She is a vessel 225 feet in length overall, with a beam of 35 feet, a depth to main deck of 13 feet 9 inches, a gross tonnage of 998.7 and has accommodation for about 230 passengers, besides carrying some 300 or 400 tons of cargo. On a load draft of 13 feet she has a speed of 13¼ knots.

General Arrangement

The hull is built of steel to the highest class of the Bureau Veritas. A continuous double bottom is fitted between the peak bulkheads. Tanks No. 1 and 4 are arranged for water ballast. Tanks No. 2 and 3 are arranged for the carriage of fuel oil and have a capacity of 80 tons. A lubricating-oil tank is fitted in the double bottom, directly under the main engines.

There are two cargo holds, two 3-ton steel cargo derricks being fitted at the fore hatch and two of 2 tons' capacity at the main hatchway.

All the deck machinery is electrically driven. The steering gear is of the electric hydraulic type, controlled by telemotor gear. All the weather deck is of teak.

Large cargo ports are fitted abreast of the fore hatchway for the handling of heavy vehicles.

Portable cattle fittings are arranged in the awning 'tween decks abreast of the fore hatchway and also on the lower deck in the fore hold.

The dining saloon is situated in the saloon deckhouse amidships, finished in polished birch and capable of seating 26 persons.

The main entrance hall and stairways are finished in polished mahogany. The smoking room is situated in the large steel deckhouse on the promenade deck and tastefully fitted up in polished mahogany. The entrance hall is also of polished mahogany. The sofa seats and backs are arranged so that they can be utilized as sleeping berths as are also those in the dining saloon. The passenger accommodations can thus be augmented when desirable.

The ladies' saloon is situated in the aft deckhouse and is finished in polished citron and cherry. The first class staterooms are all finished in white enamel. There are 56 two-berth, 2 three-berth and 8 four-berth rooms. Including the sofa berths there are sleeping accommodations for 228 persons.

The owners' cabins are fitted on the main deck on starboard side amidships and framed in polished mahogany with panels of polished birch. Two saloons are fitted on the lower deck, forward, for the accommodation of the steerage passengers.

The galley range is arranged for oil firing, the air injection being supplied from a fan driven by small motors fitted at its after end.

A large mail room, built of steel, is fitted on the main deck abaft the fore hatch.

Steam heating is fitted throughout the ship, steam being supplied from an oil-fired donkey boiler placed in the engine room.

All the saloons and corridors are ventilated by large ventilators on the natural draft system with downcast and uptake ventilators of the Boyle type. Gooseneck suction ventilators are also fitted to all staterooms where possible, so that a continuous and ample supply of fresh air can always be maintained.

The ship is electrically lighted throughout. The current is 110-volt and delivered from dynamos coupled direct to the auxiliary Diesel motors.

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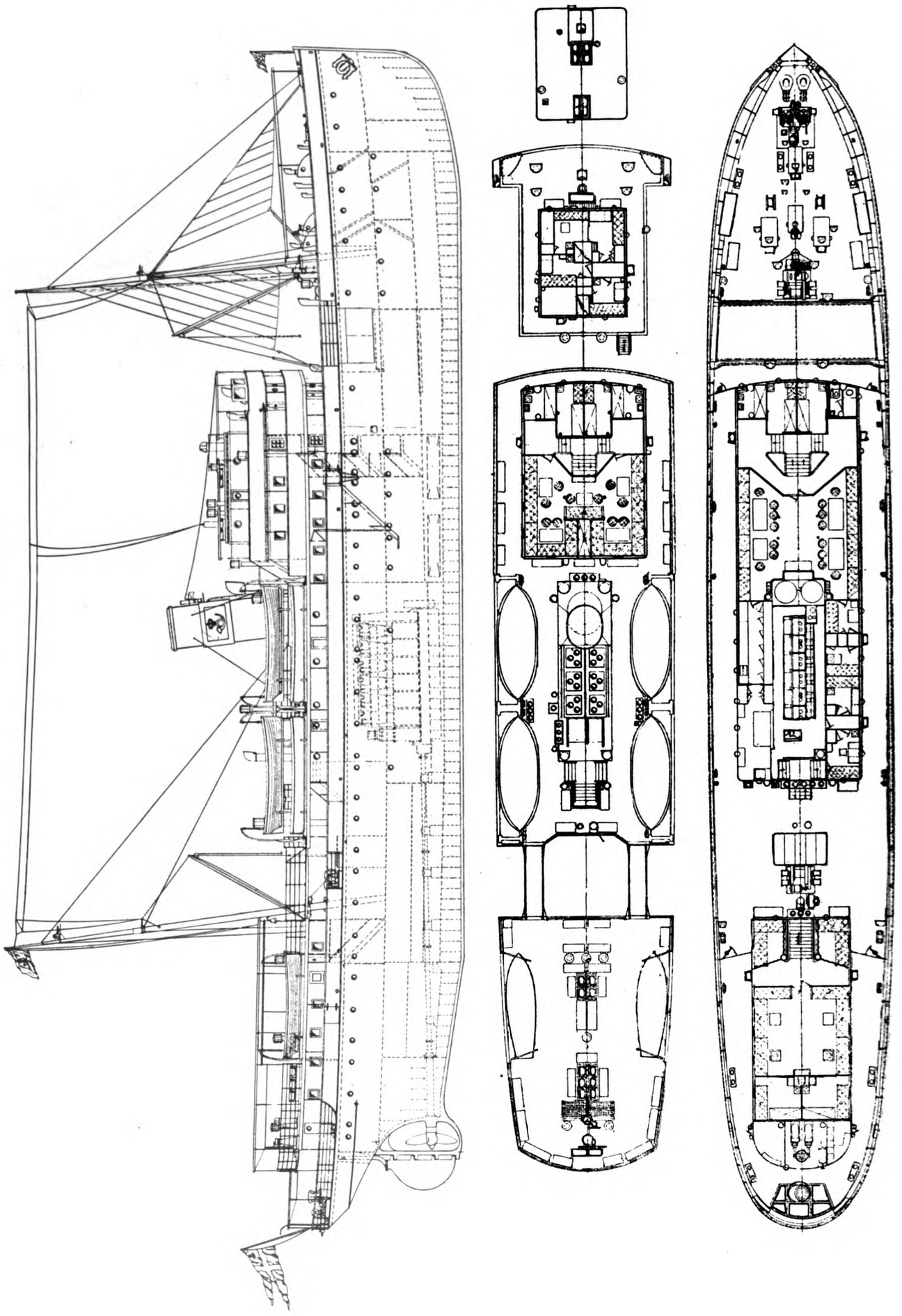

Profile and Upper Deck Plans of Motorship Frem

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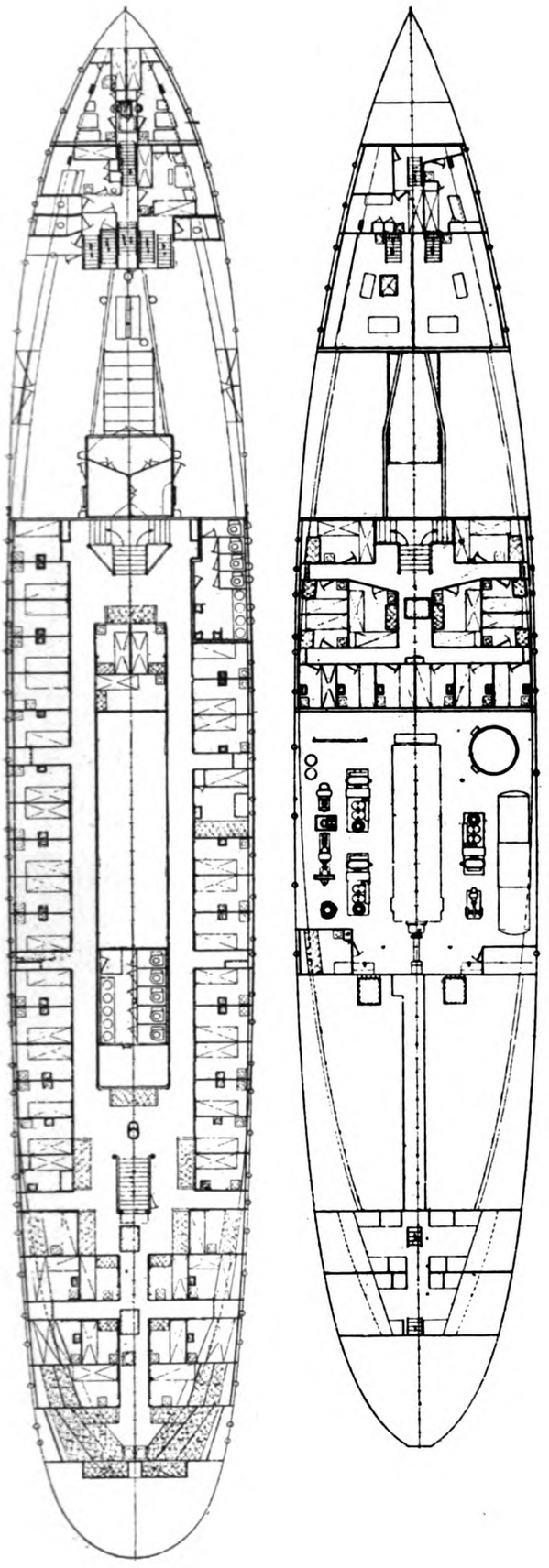

Lower Deck Plans of Motorship Frem

PROPELLING MACHINERY OF MOTORSHIP FREM

In view of the fact that for marine work, it has been generally accepted that crosshead type engines are desirable, it is noteworthy that in the *Frem* a trunk piston motor is installed. It is an engine of 1,150 indicated horsepower of the Burmeister and Wain type, and is their latest development for ships in which it is necessary to reduce the weight and, incidentally, the cost of the machinery. There are six cylinders, and the speed is about 140 revolutions per minute. The distinctive feature of the Burmeister and Wain design of long vertical push rods operating the valve levers is abandoned; the more usual arrangement of providing an overhead camshaft directly operating the valves through horizontal levers, is employed.

The stroke is made extra long in relation to the diameter of the cylinders in order to reduce the revolutions, so that the engine can be employed as a single-screw engine and allow of a propeller of large diameter being fitted, thereby ensuring good propeller efficiency.

The characteristic feature in the design of this new type of motor is lightness combined with strength, the parts of the engine which are subjected to great stresses are heavily built, while the parts which do not partake in the strength factor are of light construction.

The cylinder covers are bolted together in such a manner that they form a rigid connection at the top of the engine, and long through staybolts from the covers are carried down through the columns to the main bearings in the bedplate, the cast iron columns thus being relieved of all tensile stresses. The cylinder liners are bolted to the underside of the cylinder covers and are fitted with independent water jackets. These liners and water jackets do not transmit any thrust to the columns, therefore their walls are turned smooth, and are of gradual reduced thickness towards the bottom ends, according to the pressure in the cylinder.

There are three two-cylinder Diesel engines of Burmeister and Wain's enclosed and forced lubricated auxiliary type, driving 35 kilowatt generators.

The circulating water and lubricating oil is supplied by special electrically driven pumps. The auxiliary plant in the engine room further comprises bilge and sanitary pumps and a small ballast pump.

TRIAL TRIP

The trial trip was carried out on April 10 and was in every way satisfactory. During the consumption test the main engine developed 1,347 indicated horsepower at 146.5 revolutions per minute average at a fuel oil consumption of 0.315 pound per indicated horsepower hour, the consumption for the auxiliary plant being included in these figures.

During the trial trip a speed of 13.32 knots on the measured mile was attained, although rather rough weather was encountered.

A comparison with the owner's other vessel of similar size, the *Heimdal,* is very interesting and entirely to the advantage of the motorship, the *Frem* having accommodation for 35 percent more passengers and 15 percent more cargo.

15-KNOT MOTOR LINER ORDERED

A still more interesting development along somewhat similar lines is the order that has just been placed for a 15-knot motor passenger and cargo ship, which will be placed on the mail route between Harwich and Esbjerg, which represents the usual method of travel between England and Denmark. It has hitherto been thought that owing to the relatively low price of coal in England, the steamer would always be adopted for some services. A considerable amount of surprise has therefore been expressed at this innovation which is, however, possibly explained by the fact that the owners of the new ship are the United Steamship Company, of Copen-

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hagen, who have gained considerable experience in the operation of motor vessels in various long distance trades throughout the world.

The ship will be 304 feet long, with a beam of 44 feet and will have sleeping accommodations for 124 first class and 88 third class passengers. Refrigerated holds will be provided for between 1,000 and 1,500 tons of cargo. In this vessel, also, the Burmeister and Wain trunk-piston type of motor will be installed. There will be two sets each of 2,100 indicated horsepower and running at 195 revolutions per minute. They are six-cylinder engines, with a bore and stroke of 550 and 900 millimeters, respectively.

Arrangements will be made whereby the power can be increased when extra speed is needed to reach port in good time. This is done by installing an electrically driven supercharging blower, which will force air into the cylinders through the admission valves, at a pressure slightly above atmospheric. It is estimated that the additional power will be sufficient to raise the speed of the ship from 15 to 15½ knots, the engines being speeded up to 200 revolutions per minute. Electrical auxiliary machinery will be utilized throughout (except for heating the accommodation) and three Diesel driven generators totaling about 350 brake horsepower are to be fitted in the engine room.

The Motor Passenger Liner Aorangi

Quadruple-Screw, 17-Knot Vessel of 18,500 Tons Gross—Standardized Motorship Construction

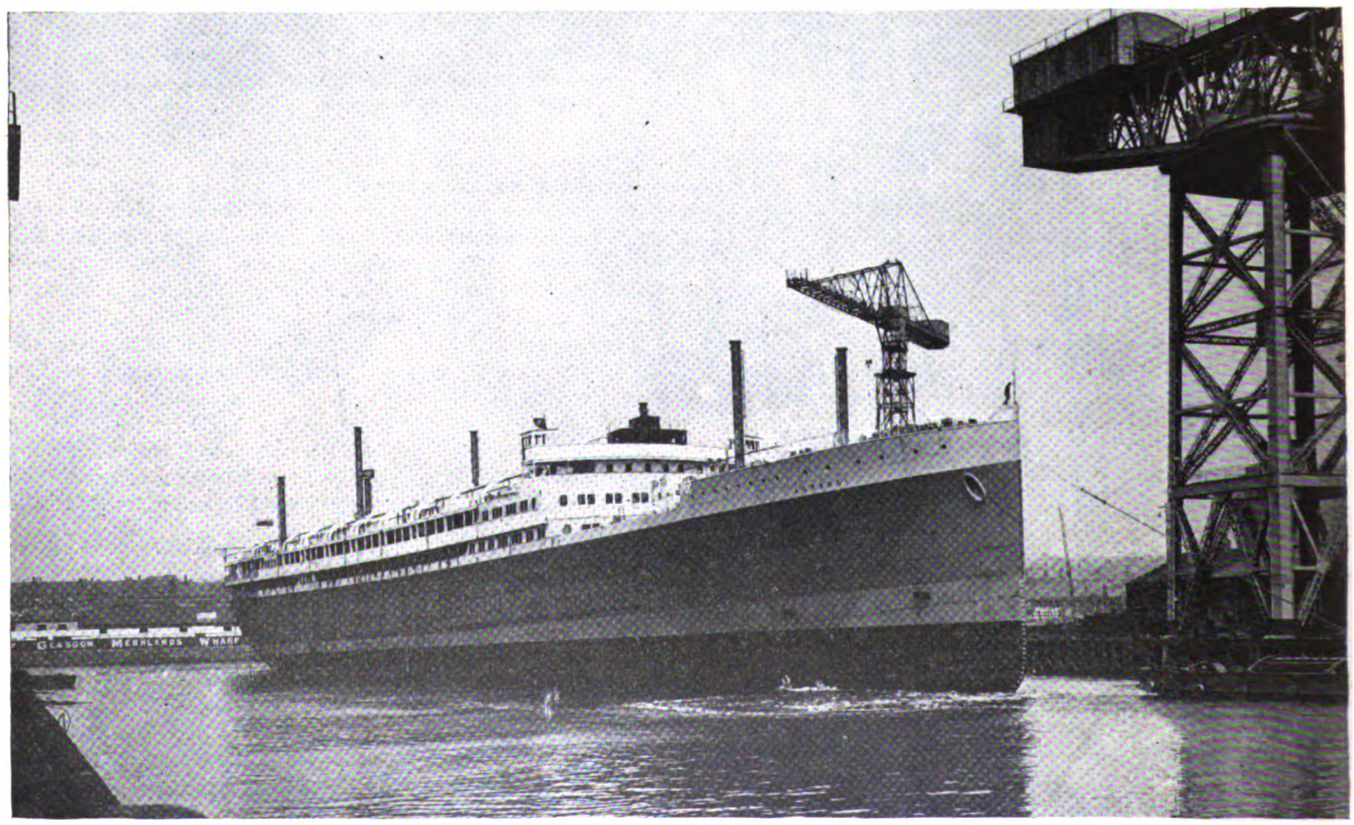
By Our Special London Correspondent

IT is hoped before the end of the year that the *Aorangi*, which is by far the largest and fastest motorship yet built, will sail on her maiden voyage across the Atlantic, and thence to Vancouver to take up regular service between that port and Australasia. She will represent all that is finest in liner construction and will have a Diesel machinery installation nearly three times as powerful as that in any existing motorship.

The *Aorangi* was launched recently from the yard of the Fairfield Shipbuilding and Engineering Company on the Clyde, her owners being the Union Steamship Company of New Zealand. She is 600 feet in length, with a beam of 72 feet and a depth of 46 feet 6 inches, the displacement being 23,000 tons and the gross tonnage 18,500.

Propelling Engines

The propelling engines were described recently in this journal and they need not be referred to at length, but it may be recalled that there are to be four sets each developing 3,250 brake horsepower at 125 revolutions per minute. They are of the Sulzer type, each with six cylinders, 27½ inches diameter and 39 inches stroke. It is of interest to make a comparison with a similar vessel equipped with a steam plant. Maintaining an average speed of 17 knots,



The Aorangi Just After Launching

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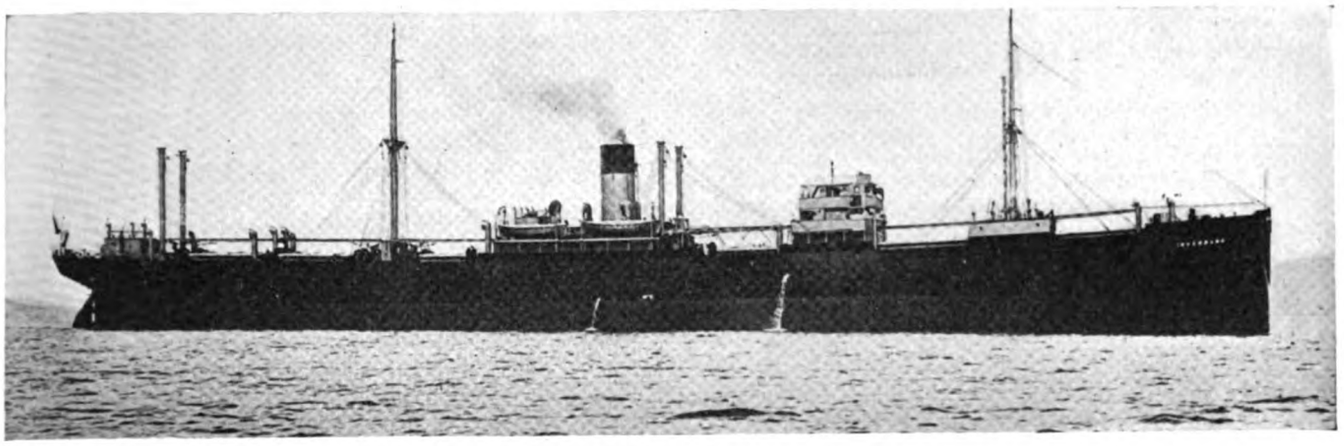


The Bank Line Motorship Inverbank

the total fuel consumption of the *Aorangi,* including that required for the operation of all the auxiliary plant, should not exceed 60 tons. It is estimated that an oil-fired geared turbine steamer for the same service would consume 2½ times as much oil, and that, in order to provide equal passenger and cargo accommodation, a vessel some 25 feet longer would have to be constructed.

In spite of the fact, therefore, that the propelling machinery of the new liner is much more expensive than corresponding steam turbines and boilers, the overall cost of the complete vessel, based on similar carrying capacity and speed, is not very greatly in excess of a steam-driven liner. In this connection, it is an interesting fact that when a new 15,000-ton, 15-knot liner was required by the Rotterdam Lloyd Steamship Company, it was found that the motor vessel would cost $200,000 more than the steamer and the order was eventually placed for an oil-engined craft.

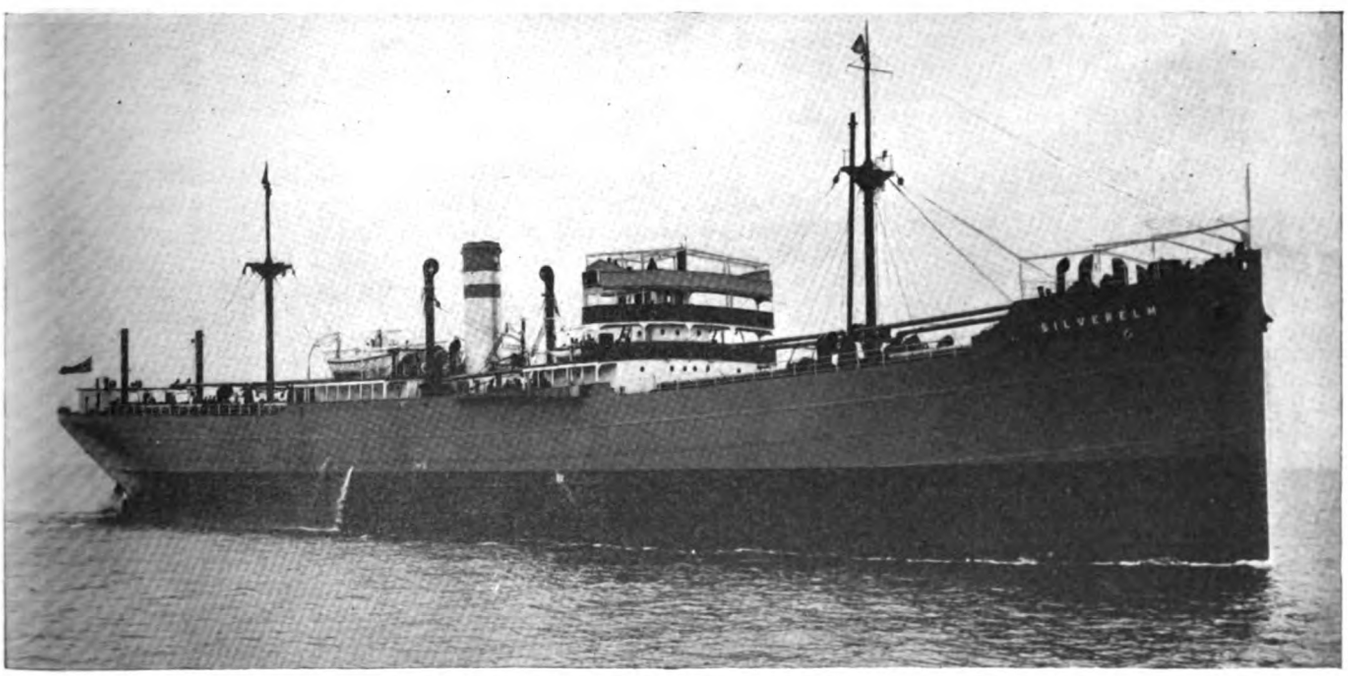
Passenger Accommodations

On the *Aorangi* there will be accommodation for nearly 950 passengers in all, and there will be cabins for 380 first class and 284 second class passengers in addition to a number of interchangeable cabins which can be utilized for first or second class as circumstances warrant. All the passenger accommodation will be arranged on the main, upper, lower, shelter and promenade decks, and in the holds there will be space for over 400,000 cubic feet of cargo, of which about one-quarter will be for refrigerated produce.

Both Steam and Electrical Auxiliaries Used

The steam and electrical auxiliary machinery will be located in a special auxiliary engine-room forward of the propelling engine-room and separated from it by the fuel tanks, which will have a total capacity of nearly 3,000 tons. All the winches are steam-driven, as well as a considerable proportion of the engine-room pumps, while steam heating will be provided. There are to be two single-ended boilers about 13 feet diameter and 10 feet 6 inches long, with a heating surface of 3,500 square feet.

A very considerable amount of electric power is needed for the operation of the turbo-blowers supplying scavenging air to the main engines. Two of these will always be in action, and as each absorbs about 300 brake horsepower the electric generating plant has to be on a large scale. There are four Sulzer type engines each of 410 brake horsepower



The Silverelm, the First of a Series of Motorships to Trade from New York to the Far East

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coupled to 250-kilowatt generators, and besides running the turbo blowers, these supply current to certain engine-room motors, the electric fans and the lighting circuits.

STANDARD MOTORSHIP BUILDING

One of the most notable features of British shipbuilding at the present time is the tendency towards the standardization of motor vessels, mainly with the object of reducing the cost of construction which for individual ships is still some 30 percent higher than that of steamers with corresponding auxiliary equipment. A good example is to be seen in the *Inverbank* which is the first of some 15 vessels of exactly similar type of machinery ordered by the Bank Line from Harland and Wolff. The second, the *Glenbank,* has also just been completed, the third, the *Birchbank,* will follow in a few weeks, and the remainder will go into commission at the rate of about one every two months.

These craft are intended mainly for service in the Far East, and represent a very useful type of cargo carrier of moderate size and speed. They are 407 feet in length with a beam of 53 feet 9 inches and a depth of 37 feet, the deadweight capacity being somewhat over 9,000 tons. They are intended to maintain a regular speed at sea in all weathers of 10 knots and are equipped with two standard Harland and Wolff engines of the Burmeister & Wain type, developing 1,150 brake horsepower. Previously, practically all the motor vessels turned out by Harland and Wolff have been equipped throughout with electrical auxiliaries, but in these new vessels, in order to reduce the cost of construction, a combination system is employed. The engine room pumps are for the most part electrically-operated but all the winches are steam-driven. It is estimated that by this arrangement a saving of several thousand pounds for each ship has been effected.

Doxfords are also constructing standardized motorships, and curiously enough, not all for the same owners. They are developing a type with a deadweight capacity of 8,000 tons and a sea speed of 10 knots, equipped with their remarkable new three-cylinder engine of 1,850 brake horsepower of which details have already been published. The first vessel of the type is the *Silverelm* which is already in service between New York and the Far East in the hands of the Rooseveldt Steamship Company. A sister ship, the *Silverfir,* ran trials at the end of June, and a third, the *Silverlarch,* will be placed in commission shortly, both of these craft being also for the Rooseveldt Company. Two more vessels of the same class are now being built for English owners—the Moor Line, controlled by Sir Walter Runciman. They are all 375 feet in length with a beam of 52 feet 6 inches and a depth of 28 feet 3 inches.

DOXFORD ENGINE INSTALLED

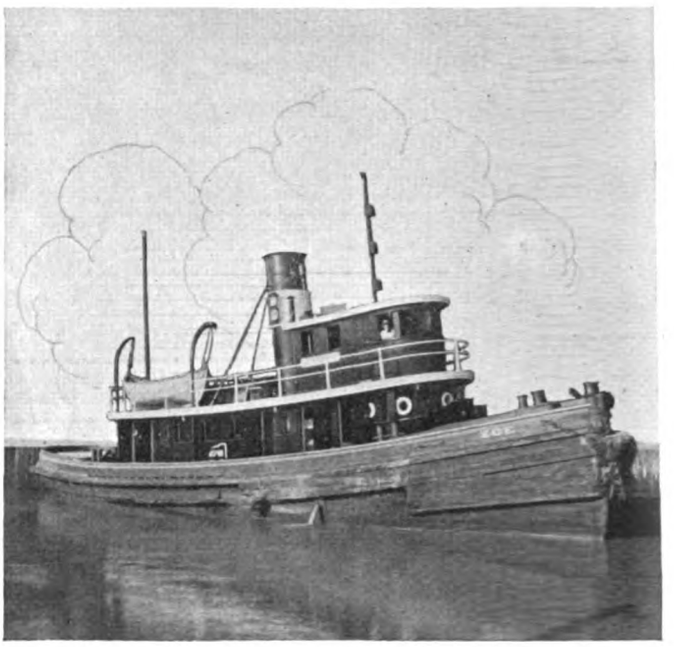
The engine is of the usual Doxford opposed-piston type, with three cylinders, 540 millimeters bore and a stroke of 1,080 millimeters. It is claimed that the daily fuel consumption of these vessels for propulsion, will be 5½ to 6 tons, at a speed of 10 knots, when fully laden, but as the auxiliaries are steam-driven, an extra amount of oil (probably about 2 tons) will be required for their operation. It should be added, however, that most of the pumps are operated direct from the propelling engines, which is a system that is likely to find increasing favor.

During the course of trials on the test bed, it was found that when using boiler oil the consumption did not exceed 0.375 pound per brake horsepower hour, which is a much lower figure than that achieved with most Diesel engines. Special arrangements are made, whereby after passing the fuel oil through a Sharples centrifugal separator, all the impurities in the water are removed, so that it is claimed the poorest grade oil may be utilized. Naturally, the fuel has to be heated before being delivered to the separators.

Motor Tug Zoe

THE *Zoe,* owned by the Bay Towing Company of Galveston, Texas, is reported to be the largest motor driven towboat in southern waters.

Originally steam propelled, the *Zoe* was badly damaged by fire and sunk in November, 1923. After the hull was refloated, the steam plant was removed and an oil engine



The *Zoe*, Said to Be the Largest Motor Tug in Southern Waters

installed, the houses and other parts damaged by fire being renewed and the vessel, in general, put in first class condition.

The *Zoe* is 87 feet long, 17 feet beam and has a draft of 9 feet. The new engine is of the Fairbanks-Morse C-O six cylinder type and develops 300 horsepower.

The fuel capacity is sufficient for 12 days' running, at full power. As a steamer, the *Zoe* could carry fuel oil for only three days' steaming.

There are now about thirty motor tugs, with engines ranging from 30 to 300 horsepower in service in the vicinity of Galveston.

Economy in Shipbuilding

(*Continued from page* 458)

enumerated were observed during the construction of ships of the highest rating in old established yards, with old time shipbuilders being the participants. Fully appreciative of the lethargic state in which many of our best shipbuilders can at present be found, the writer was somewhat hesitant about setting forth these facts. Even when business is much better than at present, with the morale of the organization considerably strengthened, it is no easy task to gain consideration for such material as this article contains, owing to the intermingling of interests and the complexity of the various factors affected. However, it can reasonably be expected that a fair percentage of the items listed can be profitably studied and investigated in every yard now building ships in this country. The writer will feel amply repaid for his time and effort, if he has been able to instil into the shipbuilders of the country a renewed interest in their work, to the end that at last a nucleus of better equipped men will be prepared, not only to put a worthy merchant marine on the seas, but also prepared to keep it there.

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Practical Diesel Engineering—II

The Use of Heat Cycles—How the Horsepower of a Reciprocating Engine Is Measured—The Indicator—Efficiencies

By Louis R. Ford*

FROM the study of theoretical cycles we get an understanding of what is occurring in the cylinders of our engine and by using the fundamental relation between pressure, temperature and volume it is possible to determine from this study what results may be expected from the engine in the way of power and efficiency. An extended analysis and explanation of the theoretical treatment of cycles is not within the scope of this discussion but some of the results obtained from this treatment will be pointed out and a short explanation given of the basis from which are obtained the mathematical formulæ used in calculations dealing with heat cycles. The details of the derivation of these formulæ and the whole study of heat cycles may be followed in any standard text book on the subject.

It has been pointed out that a pound of any one kind of fuel oil used in engines contains a definite amount of heat, measured in B.t.u's. The value of any oil as fuel is measured by this heat content and it is customary to purchase fuel oil on the basis of the number of B.t.u's per pound contained in it. This heat is liberated by burning the oil and it can be measured in the laboratory by an instrument known as a calorimeter. Heat is the source of the engine's power to do work and for every pound of oil burned in the engine there is a certain proportion of the heat liberated that can be converted to mechanical work. By comparing, then, the amount of heat converted into work with the amount of heat available in the fuel we get a measure of the goodness of any particular engine.

The starting point for this sort of calculation is the selection of the cycle on which the engine operates, then it is possible to calculate the theoretical maximum amount of work per pound of oil that can be obtained by the use of this cycle. This amount will be a certain percentage of the total amount of work, in the form of heat units, available in the pound of oil and this percentage will be the thermal efficiency of the cycle. No engine can be built that will have an actual thermal efficiency in operation greater than that of the cycle on which it operates. As a matter of fact, no engine has yet been built the thermal efficiency of which equals that of the cycle on which it operates. The correct measure, then, of an engine's efficiency is the ratio of the amount of heat per pound of oil actually converted into work in the engine to the maximum amount of heat per pound of oil that it is theoretically possible to convert into work by the use of the particular cycle on which the engine operates. In other words, if the thermal efficiency of the cycle is 52 percent and the thermal efficiency of the engine is 35 percent, then the efficiency of the engine referred to its cycle, or its mechanism efficiency, is 35/52, or 67.5 percent.

This term should not be confused with mechanical efficiency, which will be explained later. This so-called mechanism efficiency is the correct measure of how nearly the engine approaches perfection. If the maximum possible efficiency of the cycle is 52 percent, then the perfect engine could be only 52 percent efficient. If it shows an efficiency of 35 percent, then it is 67.5 percent perfect.

It is seen then that the principal use of the study of cycles, to the engineer, is to determine what may be expected of any particular engine in the way of conversion of heat to work, or how much of the possibility of its cycle is being realized in the engine. In order to make predictions or study performances it is necessary to establish a standard of reference. Now in deriving formulæ for the cycles previously described, one of the important factors entering into the calculations is the specific heat of the gases. This is the ratio between the amount of heat required to raise the temperature of a given weight of gas one degree and the amount of heat required to raise the temperature of the same weight of water one degree. The construction of usable formulæ is made difficult by the fact that this specific heat is not constant. In an engine we compress a mixture of air and burned gases. To make lubrication possible it is necessary to cool the cylinder walls and the exchange of heat between the gases and the cylinder walls causes variations in the specfic heat. In order, then, to construct equations that can be used and by which a standard reference diagram can be calculated, it is assumed that pure air is the working medium and the specific heat of air is used as a basis for the calculations. It is further assumed that this specific heat does not vary, due to heat losses. Based on these assumptions an "air card" can be calculated as representing the best possible performance of the engine, and the actual performance referred to this card. The ratio between the engine work shown by the indicator card, to be explained further on, and the possible work calculated from the air card is the "diagram factor" of the engine.

The relation between the three variables, pressure, volume and temperature, previously discussed, can be expressed in formulæ that enable it to be used in such calculations. If a gas at pressure P_1 and volume V_1 is allowed to expand, by movement of a piston in a cylinder, to a larger volume V_2, the pressure will fall to a lower pressure P_2. This relation between the two is expressed by the equation $P_1V^s_1=P_2V^s_2=C$, where C is a constant. Expressed in words, at any stage of compression or expansion the product of the pressure and the s power of the volume, for a given quantity of gas, will always be the same. The value of the exponent s is variable for different gases and different conditions of the same gas but, if the gas is assumed to be air, without any change in specific heat it will be constant. For practical purposes the s for air may be considered to have the value 1.4 and this value is ordinarily used in the formulæ. From this fundamental equation and a similar one involving temperature we can derive a set of working equations that will enable us to calculate the value of any one of our three variables, pressure, volume and temperature, corresponding to any given values of the other two.

These equations are absolutely necessary for the designer and are of great value to the operating engineer who wishes to arrive at a complete understanding of the Diesel engine. It is a fact, however, that, when considered as tools for every day engine room use, they are considerably less important than the wrench, the hammer and other "persuaders" of tangible form. For this reason they will not be further discussed but the ambitious engine operator who pursues further the study of this phase of Diesel engineering will be well repaid for his efforts by a better comprehension of what is going on inside the engine and of how the latent energy in his fuel oil is being transformed into useful work.

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HORSEPOWER

The capacity of an engine for performing work is expressed in terms of "horsepower." This term had its origin in the days of the first steam engine, when the pulling power of the London draft horse was suggested as a suitable standard by which to measure the power of this new machine. Very obviously the power of all horses was not the same and it was necessary to establish a standard amount of power that could be exerted by the average horse. In this connection it is well to observe the meanings of the terms "work" and "power."

If any object is acted upon by a force that causes it to move, a certain amount of work is done and the amount of work done in moving the object is determined by the weight of the object and the distance it is moved. For example, if a weight of one pound is moved a distance of one foot the work done amounts to one foot-pound, or if 100 pounds be moved 10 feet the work done amounts to 1,000 foot-pounds. Whether the time consumed in moving the object is one minute or one hour, the work done is just the same, although the work is done at a different rate in each case.

To determine the "power" required to do this work we must consider the time. Power is defined as the rate of doing work and is expressed in terms of foot-pounds per minute. If one pound is moved one foot in one minute, it requires a power of one foot-pound per minute but, if this same pound is moved 100 feet in one minute, a power of 100 foot-pounds per minute is required. We see, then, that power may be defined as work divided by time. Watt, the inventor of the steam engine, determined by experiment that the average London draft horse had the power to do work, over short intervals of time, equivalent to moving 33,000 pounds one foot in one minute. This was given the name "horsepower" and adopted as the standard for measuring the power of engines.

We may now consider the units that are used when we wish to apply horsepower, as defined in the foregoing, in practical work. In the engine we have a piston in a cylinder and gas at some pressure is acting on the entire surface of the piston end. The total area of the piston in square inches multiplied by the pressure of the gas in pounds per square inch expresses in pounds the equivalent of the weight to be moved. Each time the engine crank makes a complete revolution the piston moves from one end of the cylinder to the other and back again, so if the engine is running at a speed of 200 revolutions per minute, the piston will travel in one minute a distance equal to twice the stroke multiplied by 200. In an engine with a 12-inch stroke this would be 24 inches $\times$ 200 = 4,800 inches, or 400 feet per minute.

In the oil engine the gas pressure acts on only one side of the piston. In the case of the 2-cycle engine, then, with a 12-inch stroke and running at 200 revolutions per minute, the piston would make 200 working strokes and the distance the piston traveled per minute, while the gas pressure was on it, would be 12 inches $\times$ 200 = 2,400 inches, or 200 feet. Having the load on the piston and the distance in feet that it travels per minute we multiply the two together and get the amount of work done by the engine, in foot-pounds per minute. Then, since one horsepower has been defined as 33,000 foot-pounds per minute, we divide this work by 33,000 and the result will be the horsepower of the engine.

By designating each factor by a letter we get an easily remembered formula as follows:

$$\text{Horsepower of engine} = \frac{\text{PLAN}}{33{,}000}$$

Where, P = mean effective pressure in pounds per square inch on piston.
L = length of stroke in feet.
A = area of piston in square inches.
N = number of revolutions per minute.

After the operation of the four-cycle engine is explained it will be seen that its piston makes a working stroke only every second revolution, so the result obtained from the formula must be divided by 2 in determining the power of this type of engine. Another way of expressing it, in order to make the formula fit any engine, is to make N = number of working strokes per minute. This formula gives the horsepower developed in one cylinder. In the case of multi-cylinder engines the result must be multiplied by the number of cylinders to obtain the power of the whole engine.

Before proceeding further it is essential that a correct understanding of the term "mean effective pressure" be arrived at. As has been explained, a certain pressure is produced in the cylinder when the fuel is burned but as the piston moves toward the end of the cylinder the gas increases its volume and, by reason of this increase, its pressure decreases. After combustion ceases the pressure falls steadily until the end of the stroke. The pressure at the beginning of the stroke may be 500 pounds while the average pressure throughout the stroke may be but 80 pounds and we get the same result that would be produced if a pressure of 80 pounds was maintained on the piston from the beginning of the stroke to the end. This average pressure is what we call the "mean effective pressure" and it is measured from the indicator diagram.

THE INDICATOR

The indicator is an instrument for making a continuous record of the pressure throughout the stroke in order that this mean pressure may be determined. Its principle has already been briefly outlined and it will now be more fully described. Its action may be understood by reference to

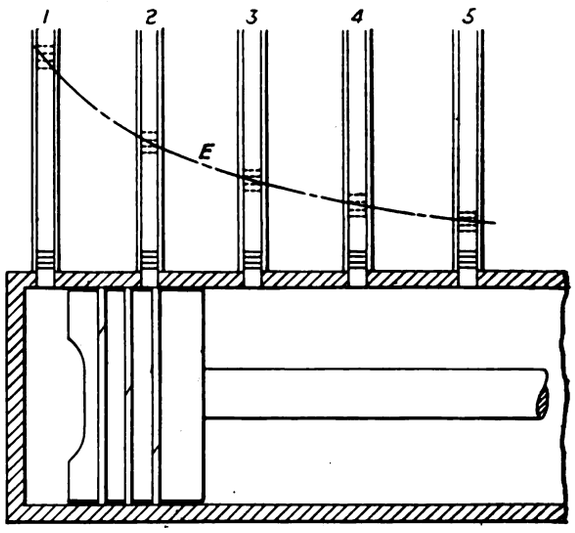

Fig. 5.—Elementary Principle of the Indicator

the sketch, Fig. 5, which has been used in early books on the steam engine.

Assume that a number of small pipes are screwed into a cylinder, as shown, with a small piston fitted in each pipe and a spring on top of each piston. Any pressure in the cylinder will force the small pistons up in the pipes against the pressure of the springs and the height to which the pistons will rise depends upon the pressure in the cylinder. Assume that when the pistons are pushed up a locking device holds them at whatever height they were forced by the pressure. Now, at the beginning of the stroke only pipe No. 1 is open to the pressure and the small piston in that pipe is forced up to the position shown by the dotted outline. As the engine piston moves along the cylinder it uncovers pipe No. 2 but by this time the expansion of the gas has reduced

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its pressure and the small piston in the pipe is not forced up as high as No. 1 was. When pipe No. 3 is uncovered by the moving piston the pressure is still less and its piston is not forced up as high as No. 2 was. If this is continued until the end of the stroke, the small pistons will be in the positions shown by the dotted outlines and, if a line is drawn through all of them, we get a curve E, whose height above a base line at any point in the stroke will indicate the pressure in the cylinder when the engine piston was at that point. Now, if instead of a number of pipes, we have one pipe on which a small, spring-loaded piston can move up and down, with a small rod carrying a pencil point attached to its upper end extending upward from the top of the piston, we can pass a sheet of paper horizontally in front of the pencil point and the curve of changing pressure, similar to the one we drew through the piston positions, will be traced on

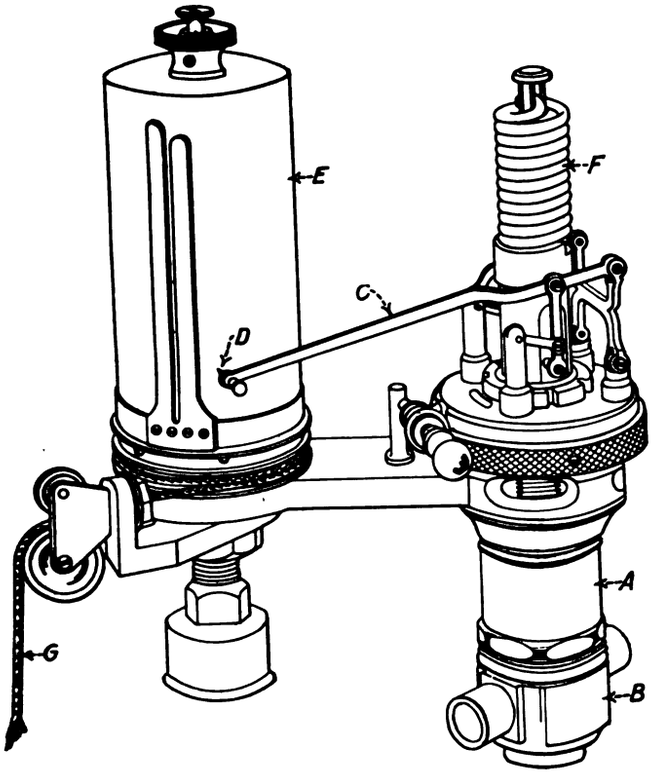

Fig. 6.—Diesel Engine Indicator (Bachrach)

the paper as the piston carrying the pencil point moves under the influence of the changing pressure in the cylinder.

The actual indicator, constructed on this principle, is shown in Fig. 6. A small cylinder *A*, which can be attached to an opening in the engine cylinder by means of the union *B*, contains a close fitting piston with a small piston rod extending through the top of the indicator cylinder. The end of this small piston rod is attached to a pencil lever *C*, so arranged that the pencil point *D* may be pressed against a revolving drum *E*. This drum carries a sheet of paper and is attached, by means of a reducing motion, to some moving part of the engine, usually the crosshead, in such a manner that it rotates back and forth as the engine piston moves back and forth in its cylinder, its rate of travel being at all times proportional to that of the engine cylinder. A spring *F* on top of the indicator piston opposes its upward movement and the scale of this spring, or the amount of pressure required to compress it one inch, determines the height to which the piston will rise under the influence of the pressure of the gas in the engine cylinder. The rotation of the drum in one direction is caused by a cord *G* wound around the base of the drum and led through pulleys to the reducing motion. Its rotation in the reverse direction is caused by a coil spring, contained in the base of the drum, which is put in tension when the drum is rotated by the cord.

With this instrument, if the pencil is held against the paper and the drum rotated, a straight, horizontal line will be drawn, if the indicator is not in connection with the engine cylinder, or if the pressure under the indicator piston is constant, but if the indicator cylinder is in communication with the engine cylinder during the completion of a cycle, a diagram will be traced on the paper that will show the pressure in the cylinder at any point in the cycle. Fig. 7 shows a typical indicator diagram from a Diesel engine cylinder.

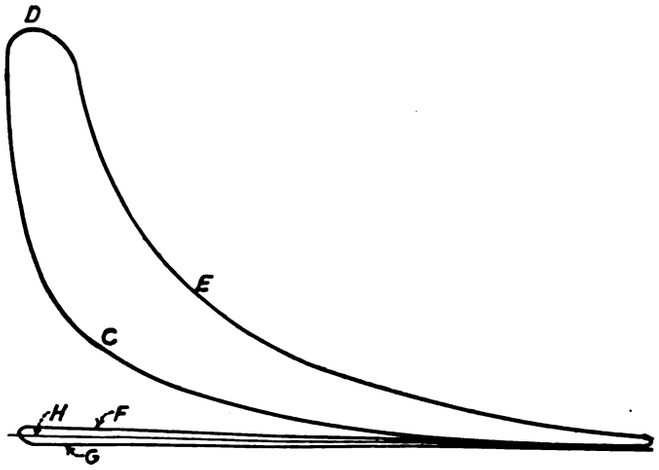

Fig. 7.—Typical Indicator Diagram

The line marked *C* is drawn when the air charge is being compressed in the cylinder and the pressure is rising. This line reaches its peak when the stroke is completed and the fuel admitted. The engine piston starts its return stroke and the indicator drum starts rotating in a direction opposite to that in which it was moving when line *C* was traced. Reference to the sketch illustrating the Diesel cycle will show that theoretically the combustion line *D* should be horizontal but in the actual engine it is rounded more or less as here shown. Best operating results are obtained when this line shows a slight rise above compression pressure. It approaches the horizontal because the pressure in the cylinder remains nearly constant during combustion and the indicator piston is held in the high position. When combustion ceases the expansion of the gas in the increasing volume of the cylinder lowers the pressure and as the indicator piston falls, under the influence of its spring, the line *E* is traced. At the end of the stroke the exhaust valve opens and the pressure in the cylinder falls to atmosphere just as the piston starts on its return stroke. During the exhaust stroke the line *F* is drawn and on the return stroke, when air is being drawn into the cylinder, line *G* is drawn. Line *H* is drawn with the indicator cylinder shut off from the engine cylinder and, since it represents atmospheric pressure, it is known as the atmospheric line. Lines *F* and *G* are shown an appreciable distance apart for the sake of clearness but in actual practice they practically coincide with the atmospheric line. The pressure above atmosphere in the cylinder during exhaust and below atmosphere during air intake is so slight that the large scale spring used permits very slight upward or downward movement of the indicator piston. Knowing the scale of the spring, that is, the amount of pressure required to compress the spring and raise the piston one inch, we can tell from the height of the lines on the diagram, above the atmospheric line, what the pressure was at any time in the cycle.

On the completed diagram all of the area under the lines *D* and *E* represents work done by the gas in expanding but

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from this must be subtracted all of the area under line *C*, because that represents work that was used up in compressing the air in the cylinder and was not, therefore, available for useful work outside of the engine. The effective pressure at any point in the stroke can be measured by subtracting the height of line *C* at this point from the height of line *E*, but for our horsepower formula we want the mean effective pressure over the whole cycle. To determine this two methods are available. That most commonly used is the planimeter method. The planimeter is an instrument which automatically measures, in square inches, the total area of the diagram, between line *C* and *E*. If this total area is divided by the length of the diagram, the result will be the average height and, knowing the scale of the spring, this gives us the mean effective pressure. If the planimeter is not available, the average height may be obtained as follows: Draw two perpendicular lines just touching the two ends of the diagram, divide the horizontal distance between these lines into ten equal parts and erect a perpendicular at each dividing point, from the atmospheric line to the combustion and expansion lines. Measure the length of each line, between the combustion or expansion lines and the compression line, add all these lengths and divide the sum by ten. The result will be the average length of the lines and if the spring scale is applied the mean effective pressure is determined.

EFFICIENCIES

The horsepower calculated by means of the formula given, using the mean pressure obtained from the indicator card, is the indicated horsepower. It is the power developed within the cylinders of the engine but it must not be considered as a measure of the power that can be delivered for doing work outside of the engine. Some power is required for keeping the engine in motion. The friction of the various rubbing surfaces and the power required to accelerate the moving parts each consume a part of the power developed within the cylinders, and in the case of engines that have air compressors or pumps attached to the engine, a large part of the power is consumed by these auxiliaries.

That part of the total horsepower of the engine that is available at the shaft coupling for doing work outside of the engine is known as the shaft or brake horsepower. The latter is the more commonly used term and has its origin in the method by which this power is measured. This method will be discussed later, but it is essentially the method in which some form of brake is attached to the crankshaft for retarding the motion of the shaft and the power measured by this brake is the indicated horsepower being developed by the engine minus the power required to keep the engine turning without load and operate the attached auxiliaries. This power measured by the brake, or the brake horsepower, divided by the horsepower measured by means of the indicator card, or the indicated horsepower, gives the mechanical efficiency of the engine.

An average figure for the mechanical efficiency of large Diesel engines operating with air injection is 75 percent and solid injection engines sometimes have a slightly higher efficiency.

When an engine is used for driving an electric generator the mechanical efficiency can be easily measured at any time by measuring the electrical output at the switchboard and applying to this electrical horsepower the indicated horsepower, as above. In using this method the efficiency of the generator itself must be known. The generator will absorb some engine power not measurable at the switchboard.

In the case of engines for ship propulsion the mechanical efficiency is determined when the engines are tested in the shop, before installation in the ship. Without some very special arrangements, the only power that can be measured after the engines are installed is the indicated horsepower.

(*To be continued*)

The Pad System Applied to Large Journal Bearings

By Major Johnstone-Taylor

THE pad system applied to large thrust bearings, as exemplified in the Michell bearing now in extended use in Europe and the Kingsbury bearing of American design, is now so well known as to need no comment beyond the fact that it has proved its worth in actual service under the severest of conditions.

The application of the system to journal bearings of large diameter such as constitute the main bearings of marine turbines and especially geared turbines is only slowly coming

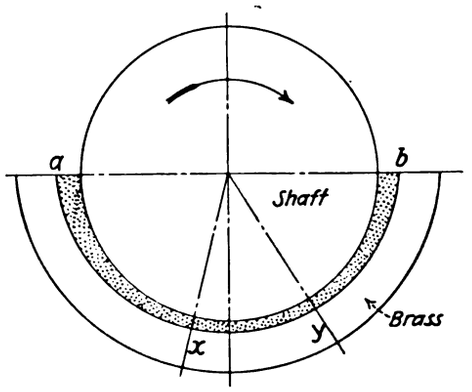

Fig. 1

into being and outside the designing room the general principles underlying this type of bearing are but little understood.

While the theory of bearing lubrication and its application in the present instance is somewhat involved, the efficiency of the actual bearing in practice is largely a matter of lubrication scientifically applied rather than of maintaining an oil film by supplying large volumes of oil under considerable artificial pressure.

The journal bearing of the orthodox type, while in a measure providing means for correct lubrication, labors under

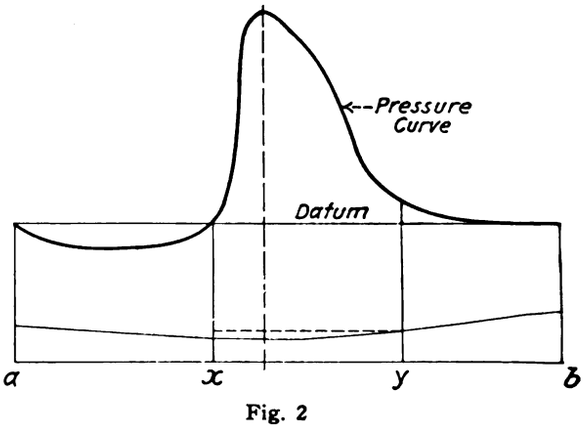

Fig. 2

certain important disadvantages which are inherent to its design and which render scientifically perfect lubrication under all conditions impossible. In the case of the ordinary bearing brass, this must be bored larger than the shaft to give the necessary working clearance and this clearance, due to expansion, etc., becomes considerably greater than the working thickness of the oil film, so that while part of the

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actual oil film may be approximately correct for load carrying it is generally only a small proportion that is actually effective. The greater the clearance the shorter will be the effective load carrying film.

In Fig. 1 a bearing is shown with a very exaggerated clearance, oil being assumed to occupy the shaded space between shaft and brass. The direction of rotation being assumed to be clockwise and the weight of the shaft to be acting downwards the shaft center naturally moves slightly towards *a*, due to the wedging action of the oil the thinnest part of the oil film occuring at or about *x*. The effective part of this film is that from *x* to *y*. In Fig. 2 the journal is laid out flat and the film shown developed from *a* to *b*. It will be observed that as the two surfaces are of different curvature, when one is laid flat the other is slightly convex. The dotted line shows the conditions when the effective portion from *x* to *y* is formed of two surfaces having the same curvature.

The resulting taper in this instance is the same as that of two plane surfaces, namely the scientifically correct form. This cannot be so with a film as indicated by the full lines of the figure. Here the film is seen to diverge from *x* to *a*, causing a partial vacuum or negative pressure film instead of a pressure or load carrying film. The pressure curvature shown crosses the datum line at *x* and from that point to *a* the negative pressure tends to draw the surfaces together instead of keeping them apart, resulting in a thnning down of the oil film at *x*, so that for a given speed the bearing will establish metallic contact at a much lower load than one with a perfectly formed film in which there is no suction.

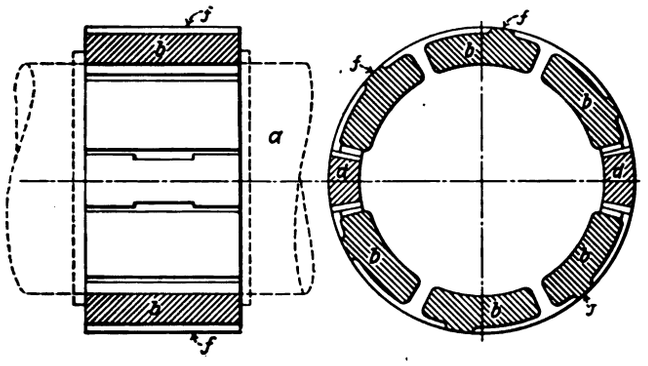

Fig. 3

Bearings constructed on the pad system cannot suffer from this defect; they are designed so that the whole of the bottom half of the journal may be supported upon effective load carrying films, these taking the place of the single ineffective semi-circle of the ordinary journal brass.

PRACTICAL APPLICATION OF THE PRINCIPLE

This is shown in Fig. 3. Shaft *a* is ground cylindrical and finished smooth. Pivoted pads *b b* are ground to exactly the same radius as the shaft and are accurately bedded thereon, the pivots *f* resting and rocking against the stationary housing, while stops *d* prevent the rotation of pads *b*. This form of construction ensures the formation of the tapered oil film which is the whole basis of the pad system whether applied to journal bearings or as is more often the case to thrust bearings. The fact that the circular rubbing faces are comparatively short in the direction of motion is instrumental in effecting this. The result is that with the same degree of safety journals constructed on the pad system will carry ten times the load of the ordinary journal brass.

A JOURNAL BEARING

An example of a large journal equipped with bearing pads in place of brasses is shown in Fig. 4 and it is interesting because it is a case where the original brasses, measuring some 15 inches from *a* to *b*, were bored out to take a ring of pads whose length is 4 13/16 inches as shown. The saving of space and the reduction of friction are obvious. In the latter connection it might be mentioned that the turbines after being fitted with these bearings ran, by their own momentum, with steam shut off for 13½ minutes, the maximum pressure on the bearing area being 550 pounds per square inch.

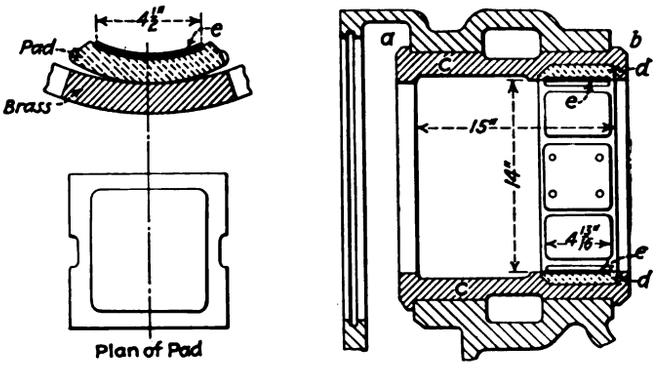

Fig. 4.—Large Journal Equipped With Bearing Pads

The diagram makes the construction plain. The housing *a b* contains brasses *c* bored out to accommodate pads *d*. These pads are lined with white metal at *e* and, as will be observed, they can rock in the housing. By reason of this ability to rock they can take up such a position with respect to the revolving shaft that a wedge shaped film of oil forms between pads and shaft. This means that lubrication goes on under ideal conditions enabling a much reduced bearing area to be used.

OTHER APPLICATIONS

Outside of marine work the field of application of this type of bearing is a wide one and such instances as steam and water turbines, large generators and motors are obvious ones.

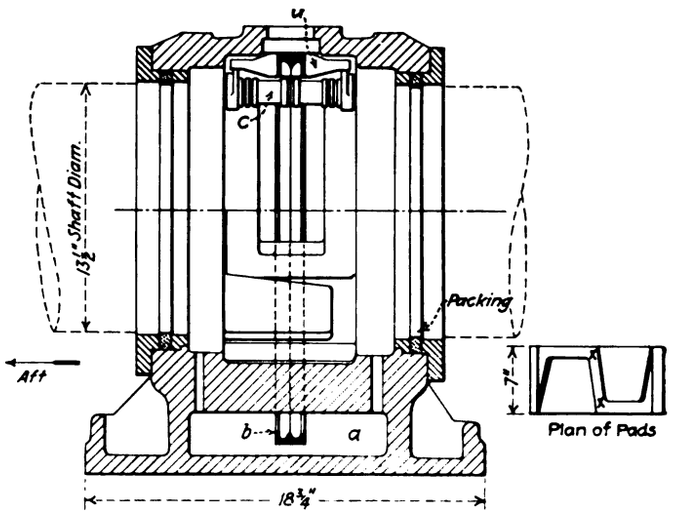

Fig. 5.—Pad Tunnel Shaft Bearing

For tunnel shaft bearings the type is eminently suited. A recent application is that of the port shaft of the T.S.S. *Philoctetes*. This shaft which transmits some 3,500 horsepower is 13½ inches in diameter and for the purpose of comparing the respective merits of plain bearings and those under discussion the starboard shaft has bearings of the

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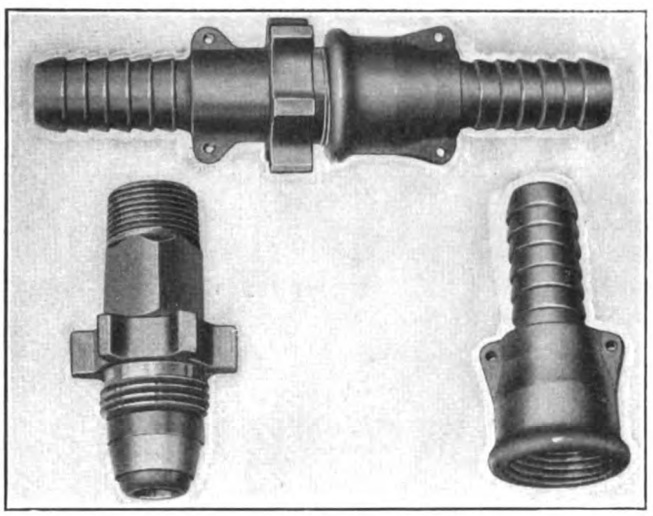
orthodox type. The pad type bearings are shown in Fig. 5.

The lubrication arrangements are of interest. There is an oil well *a* into which dips lubricating ring *b*. This ring is not quite like that of the ordinary ring oiling bearing which runs on the top of the shaft but it runs on two rollers *c* which rest upon the shaft and are driven round by frictional contact. The scraper *d* serves to remove the oil from the ring whence it drops upon the shaft. In plan the pads take the form shown, an arrangement which by reason of the channel *x x*, permits the second or trailing pad getting its proper share of oil.

Hose Coupling and Spider Hose Mender

IN view of the great amount of compressed air used in shipbuilding and repair yards it is plain that this air should be used as economically as possible. Moreover the efficient operation of thousands of pneumatic tools is dependent on the supply of an adequate amount of compressed air at the pressure required to operate the tools. A leaky hose, if it occurs too often, is the cause of considerable waste and unnecessary expense.

Realizing these facts and their relation to tight hose connection fittings the Gustin-Bacon Manufacturing Company, Kansas City, Mo., has developed a coupling and a Spider hose mender designed to be positively air tight. The coupling is a simple, positive connection without springs or locking teeth, the connection being made and wear taken up by turning a swivel nut.



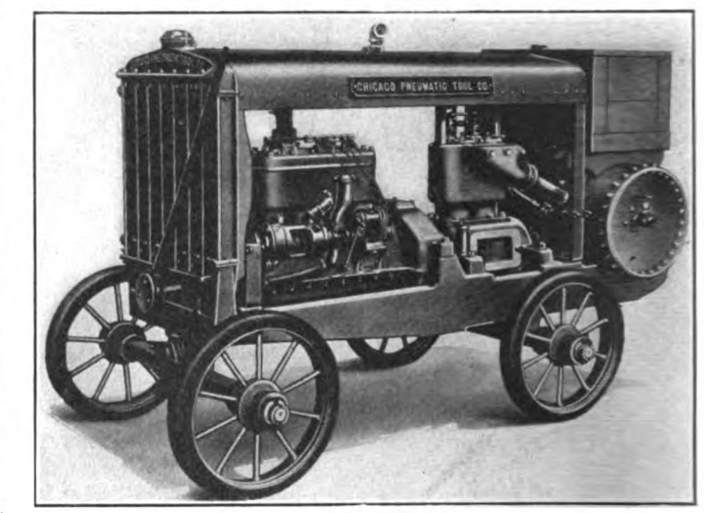
Lowrey Air Hose Coupling

Referring to the illustrations the construction of the coupling and its various parts will be evident. The gasket fits in a taper groove in the male end and turning the swivel nut forces the gasket against the shoulder in the female end. The gasket is said to be easily applied and not subject to blowing out. Special provision is made to prevent the couplings themselves from blowing out of the hose by a method of clamping shown.

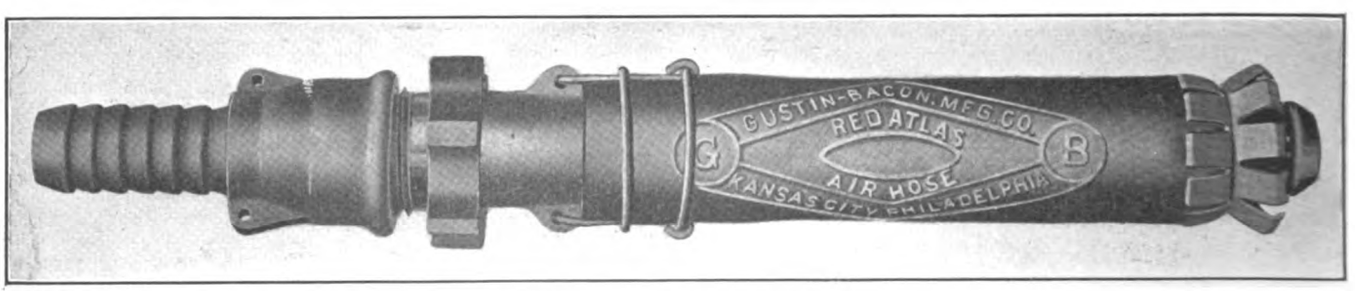
The G-B Spider hose mender, that is shown below has been designed as a simple, rapid and effective method of splicing air hose or joining the ends after a defective piece has been cut out. In applying this fitting all that is necessary is to cut the ends of the hose square, lubricate the nipple ends of the mender, slip the hose over the nipples and hammer the points into the hose. It is said that this mender will not leak or pull out under high pressures. An important advantage of this device is that on account of its short length there is practically no interference with the flexibility of the hose.

New 100-Foot Portable Compressor

THE new 100-foot Chicago Pneumatic Tool Company, New York, gasoline-engine driven portable air compressor now available is adaptable among other uses to shipyard work and will operate 2 riveting or calking hammers. The compressor is of the vertical, single-acting duplex type equipped with simplate inlet and discharge valves. The CP differential unloader regulates the air supply and the auto-pneumatic throttle provides additional fuel economy by slowing the engine to idling speed during the unloaded periods and speeding it up again just before the load is resumed. Splash lubrication is used and a small pump, gear-driven from the crankshaft, maintains a constant level of



New Chicago Pneumatic Portable Compressor



Hose Coupling Assembled and Spider Mender

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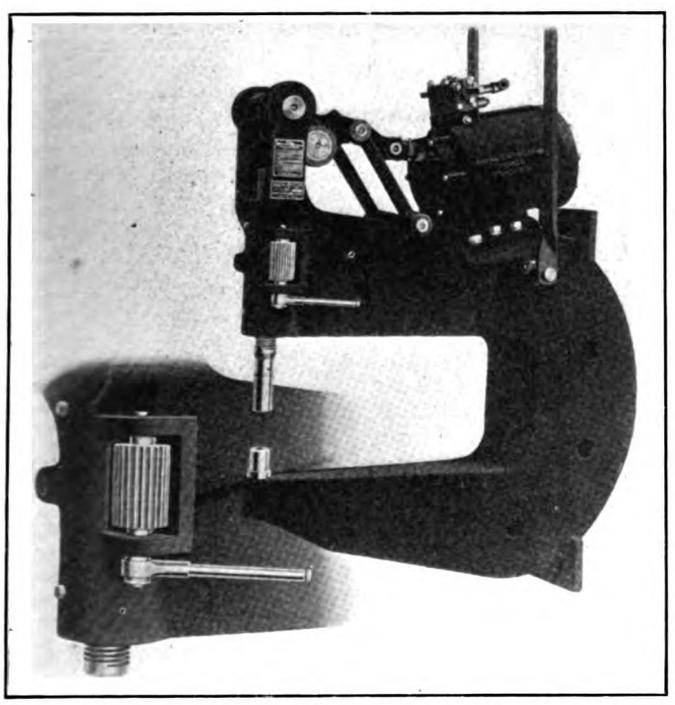
oil in the connecting rod splash troughs and supplies oil to the main bearings. Glass inserts, in the removable doors of the crank-case, are convenient for the inspection at all times of the lubrication system.

A flexible coupling, which can be quickly disconnected for starting, when desired, connects the compressor directly to a heavy-duty four-cylinder gasoline engine. Both engine and compressor are thoroughly cooled by a large capacity radiator, built in sections and protected against damage by seven vertical bars. A cast-steel deck provides a common base for engine, compressor and air receiver. The gasoline tank is carried in a separate section of the tool box which may be locked when so desired.

The complete unit is supplied in the regular steel-wheel or rubber-tired portable model, the rubber-tired trailer type or mounted on a 1-ton Ford truck chassis.

Die Screw Adjustment for the Hanna Riveting Machine

AN accessory for use in connection with its pneumatic riveter, has recently been developed by the Hanna Engineering Works, Chicago, Ill., the use of which makes possible exceptionally rapid die screw adjustment. The mechanism allows the riveting machine to be employed on



A Die Screw Adjustment Device Which Reduces Labor and Time to a Minimum

work of varied plate thickness, with very little loss of time in adjusting the dies at each new grip. With ordinary variations in thickness of plates on the Hanna pneumatic riveter it is not necessary to readjust the die screw. This is provided for in the riveter by a patented mechanism that develops a predetermined pressure uniformly throughout the last half of the piston stroke, or the last ½ inch (1 inch in machines of 100 tons and over) of rivet die travel. The motion is a combination of toggles merging into a lever action. It automatically applies sufficient pressure and follows up the shrink of the rivet under full tonnage until it is cool enough to have taken its set.

In large variations in thickness of plate the new die screw adjusting device reduces the labor and time to a minimum. A few pulls on the ratchet handle advances the die screw the desired amount in an exceedingly short time, thereby avoiding the interruption of the continuous operation of the riveter. If no adjusting device is provided and the die screw adjustment is necessary, it must be made with a pair of tongs, as the screw itself naturally becomes too hot to turn by hand.

The actual details and working mechanism of this die screw adjusting feature are clearly shown in the illustration. The rotation of the ratchet handle causes the large ratchet gear to rotate. Motion is transferred through an idler gear to the vertical gear, which is attached rigidly to a vertical gear shaft. This shaft is securely fastened by a pin to the upper end of the die screw, which it rotates. The vertical gear, the idler, the plunger, and the die screw form a single unit, which reciprocates with the mechanism. The ratchet gear is of such length that the idler can slide on it for the full stroke and remain enmeshed at all times. This mechanism is an addition to the standard riveting machine built by this company.

Rubber Sleeves Protect Propeller Shafting from Corrosion*

A NEW and important use for rubber has been developed by the United States Navy in the successful adoption of rubber sleeves for the protection of steel shafting from corrosion. Heretofore the best known method of protection took the form of composition sleeves shrunk on to the shaft in sections of such length as could be conveniently handled. The joints between the sections of the sleeve were sealed by pumping the annular ring between the overlap of adjoining sections full of red and white lead and boiled linseed oil. With the working of the shaft alternately ahead and astern, however, the joint loosened up, the lead hardened and crumbled, salt water gained admission to the shaft and active corrosion commenced immediately.

When the *Leviathan* was placed in dry dock at South Boston for repairs not long ago one of her propeller shafts was replaced by a spare, on account of a crack in one of her composition sleeves. It was noticed on this shaft that a space of approximately 18 inches between two adjacent composition sleeves was filled with a rubber sleeve. This had evidently been in place since the vessel was built, or at least seven years, and was in perfect condition except for a cut made by the hoisting slings. It was firmly adherent to the steel beneath, which was in perfect condition, with no trace of corrosion.

On docking the U. S. S. *Denver* at the Boston Navy Yard in December, 1923, it was found that serious corrosion made necessary the replacement of her propeller shaft, which, since April, 1923, had become slightly pitted circumferentially under each joint in the sleeves to a depth of approximately ⅛ inch.

A new spare stern tube shaft, completely sleeved as per old specifications, was drawn from store to replace the condemned shaft. It was 32 feet 2 inches in length and had 8 sections of composition sleeve fitted, making 7 joints in all. In view of the demonstrated inefficiency of the old-type joint, and having in mind the remarkably successful employment of a rubber sleeve on the *Leviathan's* shaft, it was decided on this to eliminate the old-style joints between the sections of sleeve and to substitute therefor rubber joints of approximately 4 inches in length.

On the propeller shaft all of the composition sleeves were

* From *The India Rubber World*. Abstract of a paper by Commander P. E. Dampman, U. S. N., in the *Journal of the American Society of Naval Engineers*, May, 1924.

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removed except the after strut bearing sleeve and a short section near the coupling, and it was decided to substitute for the sleeves removed a continuous rubber sleeve approximately 13 feet long.

The shaft was centered in a lathe and the sleeves turned off at the joints to a width of 4 inches, which width was decided upon as the shortest joint which would leave room to properly work the rubber. Each section was underscored at the ends by a 45-degree bevel from outside diameter of sleeve to shaft. The surface of the steel shaft and the undercut of sleeve was rough cut to about 14 threads per inch to aid in the cohesion of the rubber.

In applying the rubber the exposed section of shaft was first well washed with carbon bisulphide to remove all oil or grease, and then painted with two coats of rubber cement. The rubber filling, which was supplied in large rolls about a yard wide and ⅛ inch thick, was cut into sheets the proper size to go around the joint, ends scarfed where the joint occurred, and applied one layer at a time with additional strips at the ends to build up a fillet. Each layer as it was applied was well worked with small knurled rollers, great care being taken to get rid of all air bubbles or pockets, the sheet being punctured with awl or knife as necessary. After a layer was in place, it was painted generously with carbon bisulphide, as was also the next layer of rubber, which latter was painted on both sides and allowed to stand three minutes before being applied.

Three layers in all were applied, making the thickness of the rubber ⅜ inch, and the whole was then tightly bandaged with strips of muslin wound spirally under considerable tension, until the vulcanization, which proceeded automatically from the chemical action of the carbon bisulphide upon the prepared rubber, was completed. This required, at a temperature of 55 degrees F., a period of 24 hours. This time could be much reduced by raising the temperature. At 80 degrees F. 12 hours would be required and at 212 degrees F., only two hours. At the completion of the curing, the muslin bandages were removed and the rubber sleeves carefully inspected.

The long rubber sleeve on the propeller shaft, which measured 12 feet 10 inches in length, was applied in a similar manner.

It was suggested by the representative of the United States Rubber Company, who supervised the work, that a layer of rubber impregnated cords, such as are used in the manufacture of cord tires, wound tightly around the shaft just before the outside layer of rubber was applied would greatly increase the mechanical strength and durability of the rubber sleeve.

It was therefore proposed to incorporate this feature in the next job of a similar nature to develop at the Boston Navy Yard. This proved to be a spare propeller shaft for the S. S. *George Washington,* which had a rubber sleeve approximately 15 feet in length. The surface of this sleeve contained numerous fine cracks such as appear in old rubber; it was hard and brittle and had been gouged in several places. A new rubber sleeve was fitted but, in working out a scheme for securing additional mechanical strength as protection from possible abrasion, a layer of breaker fabric similar to that which is used in the construction of automobile tires was placed under the outer layer of rubber. The typical rubber sleeve, therefore, consists of two layers of rubber, followed by a layer of fabric and finally covered with a thin layer of rubber. Such sleeves are now being applied to the U. S. S. *Galveston.*

For the long rubber sleeve on the propeller shaft, which was exposed, some form of protection from mechanical injury and from possible attack by marine growths was considered advisable. (The rubber sleeve on the *Leviathan's* shaft was within the stern tube.) This protection took the form of a sheet brass strip, 1/16 inch thick and 3 inches wide, made up in a long coil with joints riveted and brazed, and wound spirally over the rubber sleeve under considerable tension. It was secured to the composition sleeves at each end by means of countersunk head machine screws.

The material used consisted of uncured sheet rubber, calendered ⅛ inch thick (United States Rubber Company compound G-520), and was furnished in rolls about a yard wide, rolled up with cotton sheeting between the layers. The cement was made by dissolving the above rubber sheet in benzol in proportions of 4½ pounds of rubber to one gallon of benzol, the benzol being chemically pure and free from carbon bisulphide. The carbon bisulphide was of the ordinary commercial grade. Precautions should be taken to store the rubber material away from the carbon bisulphide, as it is affected by the fumes of the latter; also care should be taken in handling both the benzol and bisulphide, the vapors of both being explosive when mixed with air.

Another Form of Protection

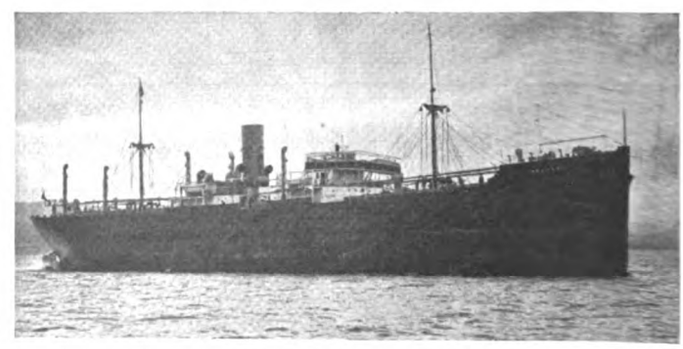
In addition to the corrosion due to leakage between sleeve joints, there has been considerable difficulty caused by leakage and corrosion at the commencement of the propeller taper. In order to secure a better and tighter joint at this place, a rubber packing ring was developed. This has now been in use for over a year and shafts recently examined have shown no signs of corrosion at the taper.

Trials of the Motor Ship Swanley

On June 30 the motorship *Swanley* built for Messrs. Harris & Dixon, Limited, of London, by Barclay, Curle & Company, Limited, and equipped with two stroke cycle double-acting Diesel engines by the North British Diesel Engine Works, concluded a series of sea trials on the Firth of Clyde. The engines, which, it will be recalled, are of an entirely novel design, worked throughout without the slightest hitch. The trials indicated that the *Swanley* will be able to maintain a speed of 10½ knots on a consumption of about 8 tons fuel oil per day, when carrying a deadweight of over 9,000 tons.

The engines have three cylinders 24½ inches diameter by 44 inches stroke driving a single screw, and develop 2,000 brake horsepower at 96 revolutions per minute. Owing to the double-acting principle these engines naturally occupy very much less space than any other type of Diesel engine of equivalent power and piston speed. Their short length results in a very large gain in capacity, amounting on the *Swanley* to 41,000 cubic feet over what would be possible with steam engines and boilers.

Throughout the trials the engines worked with the greatest smoothness and in no part of the ship was there any sign of vibration. The rapidity and certainty with which the engines were maneuvered were outstanding features. The combustion also was perfect, and at no time throughout the whole of the trials was it possible to detect any smoke or fumes issuing from the funnel.



Motorship Swanley

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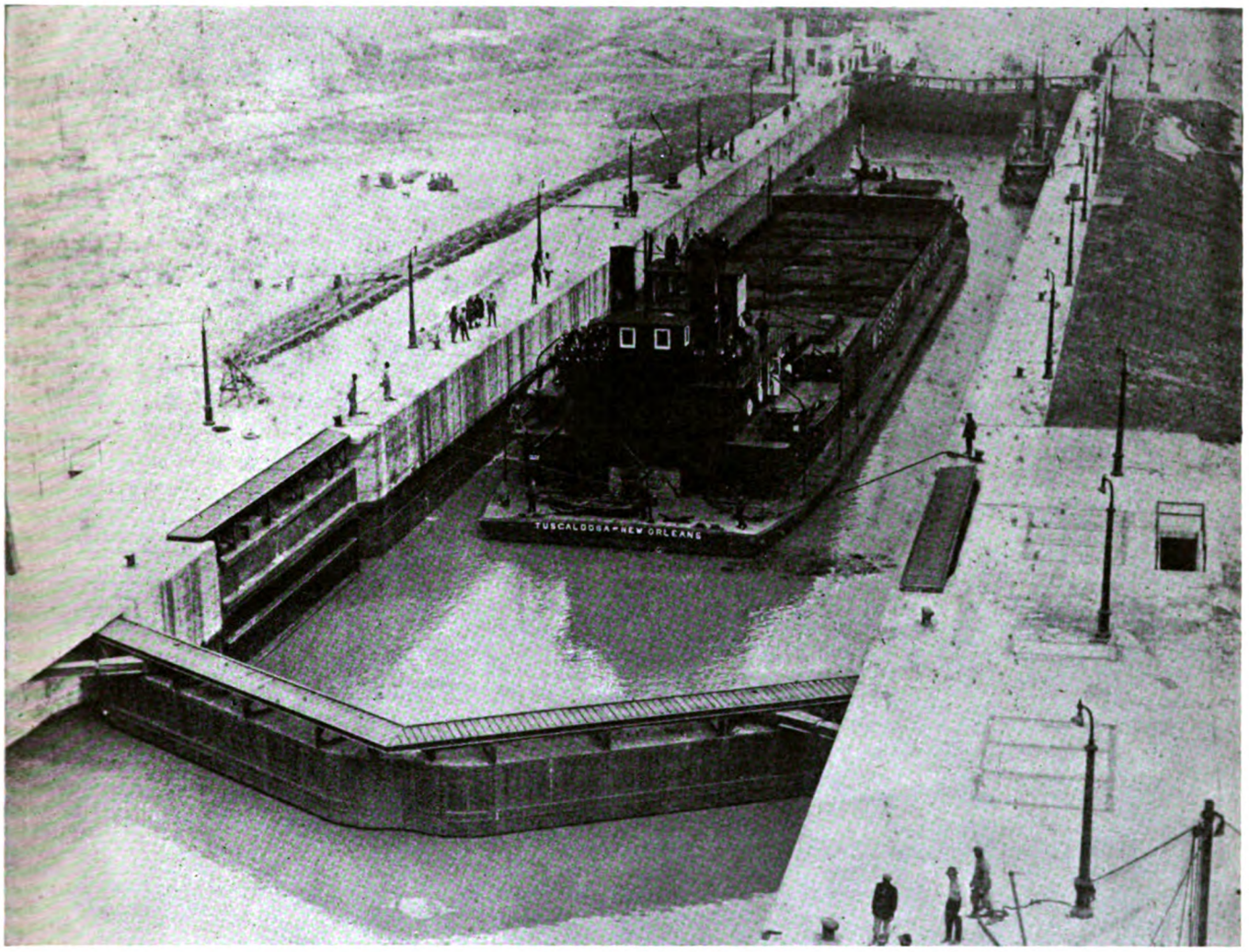
Realization of a New Character of Port Economy

New Orleans Co-ordinates Rail, Water and Highway Transportation—To Become a Port Market of Deposit and Exchange

By Walter Parker*



Modern Self-Propelled Steel Barge, of 2,000 Tons Capacity, Passing Through the Great Lock of the New Orleans $20,000,000 Industrial Canal and Inner Harbor en route from New Orleans to Birmingham, Ala.

NORTH AMERICA, long the farm and the forest for the Old World, must now become the factory for the New World and the Orient and must readjust its industrial and transportation economy.

Western Europe will continue to take our cotton, lumber, foodstuffs and the like, in so far as its finances will permit, but the United States will desire more and more to sell the finished articles of commerce rather than raw materials, and to this end there will be an ever increasing favoring spirit for the development of new markets in those overseas regions where raw materials are to be had.

Such regions, available, exist in Mexico, Central and South America, where the overflow populations of Europe may seek homes, and in the Orient, where huge populations and a relatively undisturbed economic life permit the creation of exchangeable products.

It is from the great valleys of the country, particularly of the Mississippi and its tributaries, that the food and the raw material supply of the United States must come. Within such valleys easy grade railroads and navigable waterways may be made to supply efficient transportation at low cost.

By centering the processes of industry within those valleys in close juxtaposition to food supply, raw material and the means of low cost transportation along trade channels of low natural resistance, a new and lower cost equation is created, and when such processes are carried to their logical goal, a new economic margin for business is evolved just as surely as was done when steam power and machinery replaced hand labor.

Will Offset Lower Labor Costs

When to these processes in the interior there is added the factor of scientifically co-ordinated port economy, the net saving to commerce and industry should prove great enough to offset, in overseas markets, lower labor cost levels in less

*General manager of New Orleans Association of Commerce.

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favored regions which long have been strong competitors of the United States in foreign fields.

Changing world trade routes made Carthage, developed Venice, forced the Panama Canal, and now give New Orleans a world port opportunity of a new order and an opportunity to serve the Mississippi Valley efficiently and at low cost.

To capitalize that opportunity, New Orleans, with public money, has built wharves, warehouses, elevators and terminals, and, at the beginning of 1923, completed an inner ship harbor and industrial canal, at a cost of $20,000,000. This makes possible complete co-ordination between transportation, factory and warehouse, and clears the way for continuing uninterrupted development under the following four-phase policy.

The Mississippi Valley

Broadly, the region lying between the Appalachians, the Rockies, Canada and the Gulf is an economic entity. It is called the Mississippi Valley. Within it are produced 80.8 percent of all the wheat yield of Continental United States; 86.9 percent of all the corn; 97 percent of the iron ore; 82 percent of the agricultural implements; 95.8 percent of the coal; 61.6 percent of the cotton; 52.9 percent of the lumber; 74.8 percent of the live stock; 97.5 percent of the sulphur; 66.4 percent of the salt; 70.8 percent of the oil.

The New Orleans Policy

Public ownership of river harbor front commercial sites and facilities, available to all users on equal terms—the system for a long time in operation.

Public ownership of inner harbor sites and commercial facilities thereon, subject to short term leases by business enterprise.

Public ownership of inner harbor sites, subject to long term leases, and business ownership and operation of commercial facilities thereon.

Private ownership of sites on ship laterals of the main canal, and private ownership and unhampered use of industrial facilities established on such sites.

World Changes Give New Orleans Great Opportunity

This world port opportunity of a new order arises as a result of several major causes.

The war curtailed Europe's buying power, hastened the period in which Latin America must develop, greatly augmented the industrial capacity of the United States, increased the cost of rail transportation, forced a return of inland

Modern Barge Fleet on the Mississippi River at Memphis, Carrying 16,000 Tons of Freight from New Orleans to St. Louis

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water transportation, and left the world more largely dependent than before upon the Mississippi Valley, the only producing region of the first magnitude capable of fully functioning at this time.

The huge debt imposed by the war upon all enterprise has forced men to reduce waste and lost motion, and to develop and use new economies.

Commerce can no longer be moved over indirect routes or mountain grades, when direct routes and easy grades are available, except at an uneconomic cost, which means loss of advantage in competitive fields.

The United States now needs overseas markets for the finished articles of its factories. Such markets, of great promise, now lie in Latin America, Asia and Africa, and not in Europe.

Europe will continue to need raw material from North America, but, more and more, North America will manufacture its own raw material at home, and seek to sell the products of its mills abroad.

Competition will be keen, keener than ever before, and so the process of translating raw material into finished products must take place within easy reach of the raw material, food supplies and low cost transportation.

PORT ECONOMY

As a rule, bulk commodities are produced and made ready for market at one season of the year, and must rest in store somewhere until gradually consumed by the world. The producer needs money, and so must call upon the middleman to carry the load until consuming markets become available. It follows that the greater the cost, risk and difficulty ahead of the middleman, the greater the margin of profit and expense required by him. This means lower returns to the producer and higher prices to the consumer.

It also follows that where world-used commodities are rapidly passed into consuming markets, before required for actual consumption, they often lose relative value because they can not again be offered for sale in world markets, as would be the case were they held in store in primary supply markets until actually required in some consuming market. This is well illustrated by the case of cotton. Once cotton crosses the ocean to Liverpool it must carry the cost of ocean transportation, and it can not be resold to American or Oriental mills. But so long as such cotton remains in a primary supply market such as New Orleans, it maintains its parity and may be resold into any consuming market. In most years cotton values in winter, spring and summer reflect a greater increase over fall values than the mere carrying charges amount to.

7,500-Ton Vessel in the Great Lock of the New Orleans Industrial Canal and Inner Harbor. The Lock Will Take a Vessel Three Times the Tonnage of the One Shown

Lost motion in handling, unnecessary drayage, high costs of labor, insurance and money, and delays which impose a burden on transportation are a factor of moment in every American port, and reduce the advantage American traders should naturally enjoy by reason of an abundance of raw material, unimpaired credit, and potentially low cost of transportation.

Port congestion, resulting from lack of proper planning, from personal greed, and from an absence of unselfish guidance and authority, has resulted in high charges in many American ports, which in turn narrow world competitive markets for American products.

POLICY WILL ENCOURAGE BUSINESS ENTERPRISE

Knowing these facts, and given a wide open opportunity for the testing out of schools of thought, and competitive policies, and for encouraging enterprise and business endeavor, the New Orleans port authorities have planned for today and tomorrow, and are in position to provide policies

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under which any wholesome tendency in commerce and industry may be fostered.

A market of deposit, for the products of the valley on their way abroad, and for the products of the world on their way to the valley, is on the cards. The facilities for such a market of deposit embrace complete co-ordination between rail, highway and inland water and ocean transportation, storage and mill. There is provision for certificates of storage, bearing the guaranty of the sovereign state of Louisiana, showing character, class, weight and condition of commodities in store. This means low cost money. Fire-proof waterside warehouses mean low cost insurance. Co-ordination means low cost handling.

Such warehouses may be built on leased harbor frontage by warehousemen, or built by the port authorities and leased to warehousemen, or be both owned and operated by the public, through the Port Board, as the case may require.

A municipally owned and operated belt railway system co-ordinates all rail lines entering the city, all wharves and warehouses, and all factory sites.

Through privately owned harbors and harbor sites on ship laterals of the inner harbor, industry, using either the raw products of the valley or of foreign fields, and co-ordinated with all port facilities and transportation by publicly owned belt railroad and by lighter, may, singly or in combination, develop and employ economies of a very rare character.

Ground Work

Before port development plans on such a scale and so complete in policy could be made effective, New Orleans had to do many important things. It had to devise a sewerage and drainage system for a region devoid of natural grades. This it did, in the case of sewerage, through the installation of underground automatic electric pumps which created pipe line grades between each station. In the case of drainage, a new type of low lift high capacity pump, many of them 10 feet in diameter, had to be designed for this work.

With a mighty but muddy river passing its front door, New Orleans had relied on a rain water supply for domestic use. Wells would not do, because they yield salt water only. A real water supply was required, and so a monster filtration plant, depending primarily upon coagulation and precipitation was built which now delivers a filtered pure water supply so cheaply that it is freely used to wash the streets and put out fires.

Then there was the old yellow fever problem. This problem was solved through mosquito elimination. Two hundred and fifty thousand surface cisterns were destroyed by law. These cisterns afforded the only great breeding place for the particular mosquito which can transmit the poison from one sufferer to another. The fever does not originate in any portion of the United States. It is not contagious. With no Stegomyia fasciata mosquito to transmit it, there can be no transmission. And so yellow fever, if brought into the port, can not now become epidemic.

The same is true of bubonic plague. This is a rat disease, and is transmitted through the rat flea to the human when the rat dies.

To make bubonic plague impossible in New Orleans, every residence, building, wharf, warehouse and terminal has been rat-proofed. More than two million rats have been trapped, and millions more have been poisoned. The saving in goods alone, not destroyed by rats, justifies the cost of rat-proofing, aside from its value as a health measure.

With safety from yellow fever and bubonic plague, New Orleans, a semi-tropical port, need maintain no more stringent health regulations against other ports than are required by the ports in the colder climate far to the northward. This means open commercial movement.

The wheat of the Upper Valley, and the cotton of the Lower Valley are now finding their way to ship side over joint rail and water routes at a material saving in transportation costs, and these savings should increase.

Present and Potential Resources

Louisiana's sugar, molasses and rice, and Brazil's coffee are being moved up the river on barges at low rates.

Nicaragua's mahogany is moving along the same route, while agricultural implements, automobile and many other export products are coming down.

Early in 1923 a great fleet of towboats loaded with export steel for the Orient arrived at New Orleans from Pittsburgh. It was the first of a series.

The facts all appeal strongly to the economist and to the industrial and transportation engineers, and, more or less to their surprise, the people of New Orleans are now hearing much about plans and projects for basic steel industries on their just completed inner harbor; about projected lumber and timber harbors which contemplate a trade in Central and South American hardwood, and hardwoods and pine from the southern states; wood working plants, and waste material for paper pulp, the chlorine to be available from a planned chemical harbor nearby.

This chemical harbor project has received a great deal of attention. Oil, sulphur, gas, salt are available from nearby sources of abundant supply. There are cotton, coal tar products, lime stone, gypsum near, in addition to foreign chemicals.

Plans for these great basic enterprises include co-ordination, and the maximum use of waste material.

The Italian Shipbuilding Industry

TO have an idea of the situation of the Italian shipbuilding industry during the past few years it must be noted that on July 30, 1921, the Italian mercantile marine represented 2,522,195 tons (including the tonnage transferred from Austria to Italy in consequence of the Peace Treaty) while at present Italy owns about 3,500,000 tons of mercantile vessels.

From these figures, it appears that, although during the war legislation with a strong protective tendency encouraged the creation of an excessive number of yards (Italy owns at present 27 yards with 115 berths, which could produce over 1,500,000 tons yearly) and thus placed this industry on an unsound basis, the Government action has resulted in an increase in the Italian mercantile fleet of about one million tons and has largely increased the proportion of Italian trade which is handled by Italian ships. This is an undoubted advantage to the country.

As the government could not continue paying subventions for the construction of ships for which, owing to trade depression, there was no use, an attempt was made to aid the industry by allowing the importation of a certain proportion of shipbuilding materials free of duty and also by payment of a premium based upon the price of such domestic metallic materials as were used. These benefits were conditional, however, upon the payment of certain charges by the shipyards, based on their general supply purchases.

Owing, however, to the world crisis in shipping, the above mentioned measures have been practically barren of results, although the construction of a few vessels was commenced last year.

So far, this year, there has been a slight improvement in the situation and since January 1 orders for over 70,000 tons of shipping have been placed with Italian yards, the general tendency being toward motorship construction.

Such improvement as has taken place is evidently the result of a more confident feeling on the part of shipping companies and is not due, to any great extent, to governmental action.

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Wage Demands of British Seamen Granted

British Shipowners Regard the Wage Advance as a Calamity—Shipyard Wages Also Increased in Spite of Lean Year in Shipbuilding

By W. H. Wendon

THE granting of increased wages to deck officers, engineers, stewards and able seamen on British vessels has created a situation of acute delicacy. The matter, indeed, reached the stage where the future of the National Maritime Board, which is jointly representative of shipowners and their employees, was in the balance. Fortunately for the shipping industry as a whole, differences were smoothed over, at the proverbial eleventh hour, and peace seems assured for a more or less reasonable time. The fight, however, was a sharp one, although, for the reason that it was conducted until almost the last moment without the full light of publicity upon it, it was not of a "spectacular" order. Nevertheless, the consequences, from the shipowners' viewpoint, are not trivial ones.

Briefly, the increases function as from June 5 and September 5—in other words, in two instalments. The shipowning representatives impressed on the men's delegates that the increase was quite unjustified so far as ability to pay was concerned; the truth, of course, is that, following wage advances to dock workers, seafarers determined that they, too, should have their wages revised in an upward direction. The trouble—or cycle of increases—is, therefore, easily traceable to what is universally regarded as the "weak-kneed" attitude of port employers in granting the increase to dockers without putting up a fight. They were, however, in the fortunate position of being able to pass on the additional charges.

Fate of the Maritime Board Hinged on Settlement

One of the principal reasons for the speedy settlement of the differences of opinion apropos wages is, as has been indicated, the general desire to keep alive the National Maritime Board, now in its seventh year of office. It is frankly admitted—indeed, it can hardly be contested—that the board has been an amazingly successful instrument in averting or adjusting discord between the two sections which its constituents represent. Mr. F. C. Allen, the chairman of the board, put the matter in a nutshell when he said that, if the employers declined the demands of the men's representatives, and the latter attempted to enforce those demands, then, whatever might be the ultimate result, the immediate effect would be the dissolution of the National Maritime Board and the joint supply system. He, for one—and, let me add, the great majority of owners, for their part—could see no hope of ever restoring either.

While agreeing that there was only one course to adopt, namely, to concede the men's demands, or throw the shipping trade of the kingdom into industrial confusion, shipowners are distressed at the loss of revenue which the increases will entail. The laying-up of steamers on a more or less elaborate scale has been mooted, but this is a course which takes a little time to enter upon, and in the meanwhile things may have changed for the better. At all events, so far as the present is concerned, it is sufficient to point out that British owners regard the increase as something in the nature of a calamity, one highly placed shipowner going so far as to state that "there can be no hesitation surely in anybody's mind in saying that any rise in wages whatever is absolutely unjustifiable at the present time. The position of shipping today is just about as bad as it well could be. The Plate, which is our mainstay, has taken one of its usual adverse turns, and when it will come again I do not think anyone can say. There must be many, many boats running in that quarter at the present moment that are dropping money; if that can be said of that market, what about the States, Canada, India and the East? I think shipowners could prove up to the hilt that they are losing money in running their boats, and yet this is the time taken for an advance in wages!"

Shipyard Wages Also Increasing

Shipbuilding, also, has its wage difficulties with which to contend, for, following Industrial Court awards, the cost of constructing ships in the United Kingdom automatically increases, thus accentuating the already keen competition. The formation of a reliable estimate of the percentage to be added to new contracts on the score of increased wages is naturally a hazardous procedure, but there are illuminating instances of the severity of the competition which United Kingdom builders are "up against." Holland is—for the moment, at all events—the center of this activity, one concern, the New Waterway Shipbuilding Company, of Rotterdam, having secured orders, in competition with British builders, for the construction of no fewer than four steamers, of 3,200 tons deadweight each, for Newcastle-on-Tyne owners, apart from four steamers for a Glasgow firm of shipowners, and a vessel for a leading British liner company. Fortunately for builders here, however, the past few weeks have, on the whole, been a pretty "rosy" time so far as new contracts are concerned, although, it is, of course, quite another matter whether the orders booked will ultimately prove to have been of a particularly remunerative character. The welcome influx of new work is, nevertheless, a good sign of a fairly hopeful feeling among shipowners, who, despite sundry handicaps, and weighty protests, are "risking the future" in a pretty thorough manner.

British and Norwegian Owners Order New Ships

Apropos new contracts, those owners who have taken their courage in their hands are the recipients of some glowing tributes from the builders who have handled the orders. Thus, a well-known north country shipbuilder has stated that certain owners, in ordering new vessels at once, have acted at the right moment, "as costs are at the lowest point that they can be for a considerable time." This authority also expressed confidence that the present poor time will be succeeded by a good time. And in further regard to the shipbuilding "fillip," it is not a little noteworthy that, after a spell of neglect, Norwegian shipowners are once again turning to United Kingdom builders with orders for new boats. In years gone by, Norwegians automatically came to the United Kingdom with the great majority of their contracts, and this reversion, although in a modified degree, is regarded by United Kingdom builders as a reasonably hopeful augury of "more to come."

Sir Alexander Kennedy, chairman of the Fairfield Shipbuilding and Engineering Company, Ltd., of Glasgow, is another authority who has decided views on the wisdom of shipowners who contract for new boats when the outlook is none too clear. The occasion for his remarks was the launching, from the Fairfield yard, of a notable vessel, the *Aorangi*, a motor liner for the Union Steamship Company of New Zealand. Parenthetically, as it were, it may be men-

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tioned that the *Aorangi* represents the first of twelve oil-engined passenger liners of between 14,000 and 22,000 tons which are now being built, and will only be exceeded in size by the three vessels which Messrs. Harland and Wolff are building for the Royal Mail Steam Packet Company and the Union-Castle Mail Steamship Company.

To revert to Sir Alexander Kennedy's review, he recalls that shipping during the last few years has been seriously affected by the long-continued depression in world trade, shipowners have been confronted with difficulties not hitherto experienced, and, there being no inducement, from the immediate trading point of view, to place orders for new ships, few owners cared to risk the future. But, he proceeded, the Union Company took that risk, and decided to build at a time when the future looked very black indeed, although appearances today seemed to indicate that they acted rightly. Shipbuilding, Sir Alexander Kennedy added, has passed through the leanest time in its history.

CLYDE SHIPYARD HAS AN UNPROFITABLE YEAR

Emphasis is lent to these remarks by the directors of John Brown and Company, Ltd., of Clydebank, who, in their annual report for the past year, mention that, owing to home and foreign competition (the latter assisted by low wages and low rates of exchange) prices of manufactures and shipbuilding have remained very low, and, in order to give employment to their workmen, the directors have taken many contracts at prices which cover little, or nothing, beyond wages and cost of material. Mr. Bernard Firth, the deputy-chairman of the company, "dotted the i's" of these remarks when he stated, at the annual meeting of the concern, that the shipbuilding industry in Great Britain at the present time is passing through a very trying ordeal. "While," he said, "the total volume of shipbuilding construction in progress amounts to one-half of what it was in 1914, the volume of naval ship work is only one-sixth, and I need hardly tell you how severely this hits a company such as John Brown. . . . As a result of this shortage, the prices ruling are such that no profit is included in them."

Mr. Firth added that the company had completed no really important work at Clydebank during the past twelve months, but they hoped to have a large Orient liner completed by the end of this year, together with a Cunard liner, also channel steamers for the Canadian Pacific and the English Great Western Railway. These have provided employment for a little over one-half of the men the firm employed in 1913. A further interesting remark made by the chairman was that one serious aspect was noticeable in connection with shipyard labor, and that was the large number of the most skilled mechanics who are seeking and finding work outside the United Kingdom, particularly in America, "owing doubtless to their feelings of uncertainty as regarded unemployment, aggravated in great measure by repeated disputes in labor."

In regard to the Trade Facilities Act, which, as is now well known, is a measure to ensure greater employment in the shipyards and other trades of the British Isles, it is stated in Parliament that the total amount of loans guaranteed in this connection was, up to the middle of June, £46,164,145. Of the sums guaranteed in connection with ships to be built, about £8,000,000 has been secured for vessels to be constructed by Messrs. Harland and Wolff, and of this sum about £5,150,000 is allocated to companies controlled by the Royal Mail Steam Packet Company.

SHIPPING OUTLOOK DISCOURAGING

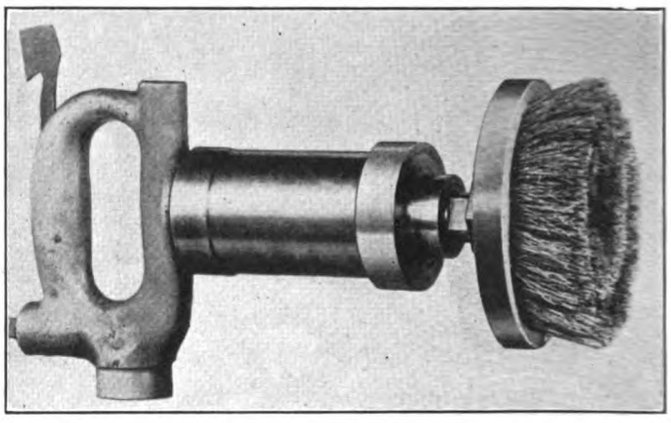
Reference has been made earlier in this review to the prospects of shipping companies following wage adjustments. The completion of the first half of the year has served to induce a number of the leading shipowners of the kingdom to give their opinions regarding the outlook, from a purely general viewpoint as distinct from what may or may not take place in consequence of the wage situation. Those whose views have been solicited are, practically without exception, pessimistic in their conception of shipping prospects for the remainder of 1924. One authority writes: "I see nothing in the immediate outlook to justify any real belief that a material improvement in shipping is at hand." Another: "There may be some trifling improvement here or there during the next few months, but I do not look for any real change for the better." A third: "The trouble that shipowners have to face is that any surplus of earnings over disbursements is wholly inadequate to meet depreciation and interest on ships built at present prices—to say nothing of those built two or three years ago—and, until this gap is bridged, either by an immense withdrawal of tonnage and greatly enhanced freights, or by a reduction of shipbuilding costs to pre-war level, there can be no prosperity for shipowners."

The foregoing are but specimens, taken at random, of representative shipping opinion in the United Kingdom, and it only remains to add that, while they are, at the best, merely a forecast, there seems no reason to anticipate that, unless some remarkably rapid change comes about, the unfavorable prognostications will not be borne out by events. As they say in the political world the only thing to do is "wait and see."

Pneumatic Surface Cleaner for Steel Plates

A PNEUMATIC surface cleaner has been developed by the Liberty Manufacturing Company, Pittsburgh, Pa., in response to the demand for an air-operated tool to remove rust, paint and scale from steel plates and flat surfaces. The machine is adapted to any service requiring the rotary motion of a steel brush.

The equipment consists of an air-operated motor, with an aluminum valve handle and a steel wire brush. A sight feed



The Liberty Surface Cleaner with a Steel Wire Brush to Clean Flat Surfaces

lubricator for distributing oil to the motor and a connection for the operating hose are also furnished. The motor is simple and rugged in construction. Air pressure acts behind a pair of semi-balanced blades which are inserted in a long, hardened steel shaft mounted eccentrically in the cylinder. An air pressure of 50 to 75 lb. is recommended for operating the cleaner.

The complete outfit weighs about nine pounds, and has an approximate overall length of one foot. The valve arrangement at the rear makes the cleaner easy and convenient to control.

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Residual Stress and Other Fundamentals in the Design of Metal Arc Welded Ships and Welded Structures in General

By James W. Owens*

THE writer has followed with interest the series of articles in MARINE ENGINEERING AND SHIPPING AGE by Mr. E. H. Ewertz, covering available information on the application of arc welding to ship construction. The collection of this information, and its preparation in a form suitable for publication, represents considerable labor on the part of Mr. Ewertz; nevertheless, there is, except in Lloyd's rules on joint design given in his last article in the February issue, a lack of fundamental information which a designer must have if he is successfully to apply metal arc welding to the repair and construction of ships.

The article in which Lloyd's rules are given concludes with the following quotation from a paper by Mr. F. B. Webster:

"Another custom and prejudice to be overcome is the overlapped and strapped joint. We have seen from the tests described above that the butt joint is the strongest, both for tensile strength and alternating stresses, but in spite of this, Lloyd's require the lap joint. The lap joint is not only weaker, but it is a positive menace."

As Lloyd's rules and the views expressed by Mr. Webster are diametrically opposite, it is evident that both cannot be correct, consequently a ship designer, considering the use of metal arc welding, will be literally at sea. Under the circumstances, one can hardly blame shipbuilders for sticking to riveting until there is a more general knowledge of the fundamental principles of welding, consequently, I have very largely confined my article to a statement of fundamentals, as I have been enabled to arrive at them through extensive research for the Bureau of Construction and Repair of the U. S. Navy for several years, and a critical analysis of practical welding conditions and service tests of welded structures, which it has also been my privilege to supervise and observe in this research program. I will preface this article by stating that I am in agreement with Lloyd's on the question of joint design, *i.e.*, their requirement that lap joints be used and not butt joints, and that, should a butt joint be used, it must be strapped.

SELECTION OF JOINTS

In selecting a welded joint to be used in a ship's structure, or indeed any type of structure, the following should be considered, relative importance being in the order given:

(a) Value of residual stress in the joint or structure.
(b) Mechanical properties of the joint.
(c) Ease of assembly.
(d) Facility of welding.
(e) Speed and cost.

VALUE OF RESIDUAL STRESS IN THE JOINT

Residual stress may be defined as "the stress or stresses remaining in a welded joint or structure on completion of welding:"† This stress is ad-fected, that is, raised or lowered, by many factors, the principal ones being:

Form of welding used,
Carbon content of the base metal,
Type of joint.

The laws of residual stress are as absolute as the law of gravity and the designer of welded structures, the failure of a weld of which might involve a loss of life, should give the subject serious thought.

FORM OF WELDING

Metal arc welding is the only form of welding considered in this article, as *gas welding* is unsuitable for the welding

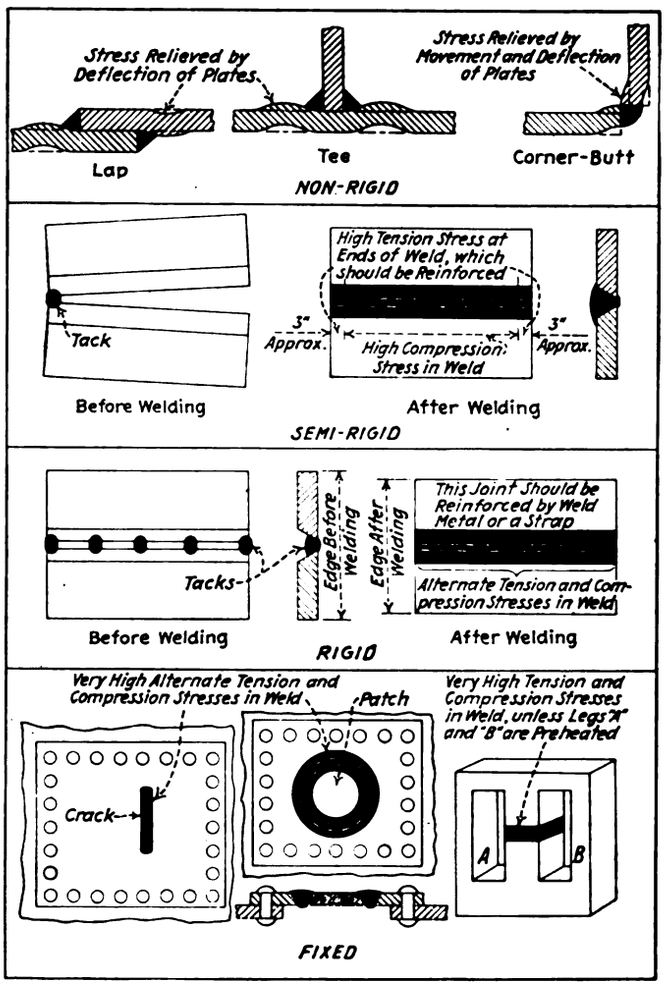

Fig. 1.—Types of Joints

of the hull of a ship, due to the general necessity of using the semi-rigid type of joint, which requires a free movement of at least one plate during welding; *thermit welding* is only applicable to the welding of heavy sections, such as a broken stern frame; and *resistance welding* has not as yet reached a stage of development which warrants consideration.

CARBON CONTENT OF THE BASE METAL

The higher the carbon content of the base metal, the higher the residual stress, consequently ingot iron has the lowest residual stress and should therefore preferably be used for

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† "Fundamentals of Welding," by James W. Owens.

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butt joints as specified later. Ship steel as at present used for the riveted structure has a carbon content of approximately 0.25 percent, therefore, if a decided extension of welding is to be seriously considered by shipbuilders, this steel must be used, as it is available and readily obtained under present specifications; furthermore, it is essential that the joints which are incorporated in a 0.25 percent carbon steel structure be those in which the residual stress is low, so that there is no possibility of failure from this cause.

As welding gains a foothold in shipbuilding, there certainly will come refinements which will call for a change in the present specifications for ship steel thus permitting the use, to a greater or less extent, of butt joints.

The specifications for steel to be welded prepared by the American Welding Society and the American Society of Mechanical Engineers require a carbon content not in excess of 0.15 percent, but it must be borne in mind that the material ordered under these specifications is used principally for the fabrication of un-fired pressure vessels, the designers of which frequently specify butt joints.

Types of Joint

Joints have been classified by the writer into four principal types, viz., the non-rigid, semi-rigid, rigid and fixed (see Fig. 1). This classification is based largely on practical considerations, involving a number of factors, the most important of which is the value and distribution of *residual tension stress in the weld metal* of the joint.

The residual tension stress in the weld metal of the non-rigid type is the lowest, that in the semi-rigid and rigid types come next, although distribution is different in each, while the tension stress in the weld metal of the fixed type is the highest of all.

Examples of the non-rigid type of joint are the lap, tee, corner butt and the open butt strap, this latter being merely a butt strap joint in which the edges of the butt are straight, separated by a distance of at least twice the thickness of the

Fig. 2.—Open Butt Strap Joint

metal, and all edges welded by independent fillets (see Figs. 1 and 2).

The resistance to the contraction forces of the weld metal in these joints is low, producing a bending moment in the section, thus securing direct tension stresses which are uniformly distributed throughout the joint. *No cracked welds have ever been observed by the writer in this type of joint, either in welds made under laboratory conditions or in sea-going structures in locations where they were subjected to maximum stress.* Welds referred to involved a large number of test specimens, thousands of feet of structural welding, and were made in standard ship plate up to 40 pounds in weight. No particular weld or layer sequence was adhered to, the number of layers used varied from one to four, and electrodes up to 7/16 inch in diameter were used, with current values as high as 375 to 400 amperes.

The semi-rigid type of joint (Figs. 1 and 3), is a double-bevel butt joint, having its surfaces in the same plane, joint edges allowed to close gradually as welding proceeds, and weld made in one unbroken layer. The weld metal of the completed joint is in tension for about 3 inches at each end of the weld, the remaining weld metal being in compression.

Apart from the high tension stress in the ends of the joint, this type of joint is unsuitable for ship construction due to the necessity of having at least one plate free to move as welding proceeds. A blow is not necessary to cause failure, and when it does occur, will always take place at the ends of the joint. This stress distribution and location of failures has been proved by the writer in numerous tests, and observations of structural welds.

The rigid type of joint (Figs. 1 and 3), can be either of double-bevel or double-vee butt form. Its surfaces are, like the semi-rigid type, in the same plane. Joint edges are parallel, tacked prior to welding, and at least one of the plates must be free to move as welding proceeds. If this latter condition is not fulfilled, the joint automatically becomes a fixed type, with even greater residual stresses. The weld metal of the rigid type of joint is alternately in tension and compression throughout the whole length of the joint, and

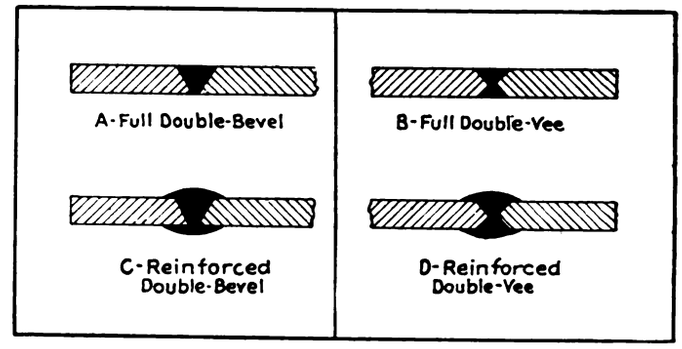

Fig. 3.—Full and Reinforced Butt Joints

failure is likely to take place in any section of the joint, a blow not being necessary. A blow on a compression area is likely to cause failure in an adjacent tension area. This distribution of stress and location of failures has, like the semi-rigid type, been proved to the writer's satisfaction.

Examples of the fixed type of joint (Figs. 1 and 3), are a prepared crack in the central portion of a plate of comparatively large area, and a butt welded patch in the port hole of a ship. Joints may be of double-bevel or double-vee butt form.

In such joints, there is either no possibility of movement of joint edges, as in the previous type, to partially relieve the forces of contraction set up by the cooling weld metal, or all possibility of movement is eliminated by the weld metal itself soon after the weld is commenced, consequently contraction of the weld metal can take place only by elongation of the fibers of the base and weld metals. Distribution of stress and its magnitude, also location, cause and extensiveness of failures are similar to that of the rigid type of joint. As noted under the rigid type, the stresses in the fixed type are of a much higher magnitude. Failure is more likely to start at the finishing point of the weld. These conditions have also been proved to the writer's satisfaction.

Dangerous Types of Joint in Ship Structures

The tension stress in the weld metal of the semi-rigid, rigid and fixed types of joint are of such magnitude in standard ship plate of 0.25 percent carbon content, as to require these joints to be classed as dangerous when used in weights of material as employed in the strength members of a ship. A crack once started, in these types of joint, is likely to extend throughout the whole length of the joint and might even continue into the component parts of the structure, due to the phenomena of "crack continuity," as will be shown in the service tests of welded bilge keels referred to later. These stresses are of lower magnitude in material of lighter weights, *e.g.*, 7½ pounds, due to the short transverse contraction length of the weld metal, less heat required to produce fusion, relative ease of warping, etc. When these types of joint are used in a ship's structure, they should always be reinforced by a strap as required by Lloyd's, with the additional requirement, that the butt be welded before the second fillet of the strap.

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The writer considers that reinforcement of a butt joint in 0.25 percent carbon steel by weld metal, will not take care of the additional stresses to which a ship structure is subjected under sea-going conditions.

Mechanical Properties of the Joint

Lap, Tee, Corner-Butt and Open Butt Strap Joints. Using standard ship plate and bare low carbon steel electrodes, the writer has found that a 40 percent efficiency can be expected with a full continuous fillet weld on one edge of the *lap*, 90 to 100 percent efficiency with a full continuous weld on both edges of the lap. If fillet welds are reinforced so that the throat of the weld is 10 to 15 percent greater than the plate thickness, an efficiency of 65 percent can be obtained with one fillet weld, and fracture will consistently occur in the plate with both fillet welds thus reinforced.

When two fillet welds are used, bending, whether due to a static load or impact, will always take place in the plate, and not in the weld, due to the stiffness of the joint. This joint is, therefore, ideal for ship structures, as working stresses are entirely in the base metal and, in case of collision, there is small chance of the weld failing. The second fillet introduces a factor of safety, for should poor fusion, by any chance, exist in a section of one fillet weld, the second fillet would likely insure an efficiency high enough to be within the factor of safety allowed in the design.

Should joggled laps be used, the weld should not be made in the joggle, a distance of at least ⅛ inch being left between the bottom of the joggle and the toe of the fillet weld. If design requires the joggle to be filled with weld metal, this weld should be made before the one on the other edge; the writer, however, considers that an element of risk would be introduced in a ship's structure should a joggled lap be so welded in standard ship plate.

The comments on the lap joint are also applicable to *tee and open-butt strap joints.* Consideration should be given to the reinforcement of the *corner-butt joint,* when this joint is introduced into a strength member. Reinforcement can be made by weld metal on the open side of the joint. Additional reinforcement can be secured by weld metal on the inside of the corner; however, to effectively transfer working stresses from the weld metal of the joint to the plate material, consideration should be given to the use of an angle or angle clips, either on the inside or the outside of the corner.

Any efficiency desired by the designer can be secured with lap, tee and open butt strap joints, as weight and continuity of weld metal can be varied within wide limits by using combinations of light, full and reinforced welds, with broken and unbroken weld sequences. In corner-butt welds, 100 percent efficiency can be obtained by reinforcement as specified.

Butt Joints. The writer does not recall ever having tested either a double-bevel or a double-vee butt joint made with bare low carbon steel electrodes, using 15 or 20 pound standard ship plate, which has shown an efficiency of 100 percent in tension when the weld metal has been ground flush (Fig. 3) with the surfaces of the base metal; however, he has consistently had the base metal fail when these joints have been reinforced on both sides (Fig. 3) about 20 percent of the thickness of the base metal. In double-bevel butt welds, reinforcement on the bottom of the bevel was the same width as that on the open side of the bevel, and extended on to the base metal on both sides of the bevel. He considers that the average efficiency of un-reinforced double-bevel or double-vee butt welds in standard ship plate should not be estimated higher than 40 percent. It must not be overlooked, however, that the possibility of failure from residual stress is always present.

Other investigators have, I believe, secured 100 percent efficiency in test specimens of un-reinforced butt welds in ship plate using alloy electrodes, nevertheless the magnitude and distribution of residual stresses in a butt weld of a test specimen and those in a structural butt weld are not necessarily the same due to the fact that the fixities of the two welds might be widely apart on account of the comparatively small size of the specimen and the large area of the plates welded in the structure, and other factors introduced by the very nature of the job; consequently the danger of failure of the structural weld from this stress is ever present.

Ease of Assembly

Lap, Tee, Corner-Butt, and Open Butt Strap Joints. Lap, and open-butt strap joints are ideal for assembly. Plates can be ordered neat as it does not make any difference whether the lap is plus or minus an amount within reason, and surfaces can be in intimate contact. In general, ⅞ inch assembly holes are punched in the center of the lap, 2 to 3 feet apart for ¾ inch bolts. Holes are subsequently welded, or plugged and welded. The weight of the structure can be reduced by making the width of the lap ½ or ¾ inch, but as this would not permit the use of an assembly bolt through the faying surfaces, holes can be punched in one plate adjacent to the lap and a strap used to pull the surfaces together. Such a joint is stiffer than a butt joint and has all the inherent advantages of the lap joint without the disadvantages of the butt.

If both fillets are welded in a non-watertight structure, such as a battle towing target, and a narrow lap used, the cost of welding the holes is avoided, if it is desired to keep water out of the faying surfaces so as to eliminate corrosion.

Tee and corner-butt joints are readily assembled by angle clips, holes in plates being punched on centers used for the lap joint. The edge of the plate forming the tee should not be beveled, and can be assembled in close contact with the other plate. If a backing strip is used in the welding of a 90 degree corner butt with high current values, it is not necessary to have these edges ⅛ to 3/16 inch apart, as is generally customary in butt welds. With corner butt welds having an acute angle, this opening is essential to secure fusion in the bottom of the weld.

Butt Joints

Except in very light metal, it is necessary that the edges of the rigid and fixed types of butt joints be assembled so that they are ⅛ to 3/16 inch apart in order to secure fusion in the bottom of the bevel, or center of vee, and to prevent plate edges overlapping during welding.

Due to the foregoing, considerable difficulty is encountered in securing proper alinement. It is also necessary to tack the joint edges prior to welding, tacks being spaced approximately 6 inches apart. The cost of fabrication and assembly is much greater in this form of joint due to the labor required in beveling the joint edges, difficulty of assembly and cost of tacking.

Facility of Welding

Lap, Tee, Corner-Butt and Open Butt Strap Joints. Beveling of plate edges is not necessary in these joints; uniform heat conduction is secured in the weld, and electrodes as large as 7/16 inch diameter can be used with current values as high as 375 or 400 amperes. These high current values *insure* deep penetration, uniform fusion eliminates inspection of every foot of the weld and overcomes the criticism of those who maintain that a weld cannot be inspected and a riveted joint can be.

The writer has seen inspected riveted joints in a ship structure in which the rivets were not driven home, thus casting doubt on the supposed unfailing reliability of tapping rivets with a machinist's hammer to determine soundness.

Full welds in these joints can be made by one layer, and there is no necessity of an unbroken layer sequence to keep the temperature of the joint within practical welding conditions. A step-back section sequence is sometimes used for

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one layer welds in order to employ very high current values and yet keep the joint temperature low; however, a step-back section sequence is usually not necessary for the second layer, or the second fillet of lap and tee joints.

Butt Joints. Unless a semi-rigid type of joint is used, it is usually necessary to make welds, in 15 and 20-pound plate, in two layers. Electrodes above 3/16 inch diameter are not in general advisable, and great care has to be exercised by the welder to prevent the liquification of too much metal in the bottom of the bevel, which usually requires low current values for the first layer, with the possibility of poor fusion; or the use of a backing strip. Non-uniform fusion in the bottom of double bevel, and slag in the center of double-vee butt welds are likely to occur.

Speed and Cost

In the comparative construction of riveted and welded battle towing targets at the Norfolk Navy Yard, lap, tee and open butt strap joints in 15-pound ship plate were welded in the flat position with ⅜ and 7/16 inch electrodes, and one continuous layer. A maximum rate of deposit was obtained in excess of 5 pounds of metal per man hour, with an average rate of 3.5; and a maximum speed in excess of 12 feet per man hour, with an average of 7.75. With this rate of deposit, the actual cost of labor and material to drive the rivets was practically the same as that of welding. With the further development of automatic and semi-automatic machines, suitable for ¼ and ⅜ inch electrodes, the actual cost of depositing the metal will be much lower than the actual cost of driving the rivets. The direct labor costs on every other item involved in fabrication, preparation and assembly are lower for the welded targets, except the cost of moving material, which is slightly greater because welded targets are turned over to facilitate welding. The total saving in direct labor on fabrication, preparation and assembly was approximately 21 percent in favor of the welded target. The saving in weight of material was about 10 percent.

If the targets were watertight structures, the total savings in direct labor would have been greater, for the riveted joint would have to be carefully calked.

It is not believed that savings in direct labor would be as high, if butt joints were used in the welded targets. The savings in weight of material would have been greater but the structure would not be as strong, as it would lose the stiffening effect of the lap joint.

Practical Proofs

The following practical proofs are submitted to show the un-reliability of the semi-rigid, rigid and fixed types of joint in standard ship plate and the reliability of the non-rigid type of joint in the same class of material:

(a) Fifty students taking the metal arc welding course at the Norfolk Navy Yard were required to make several test welds on the completion of their course. The plates welded were 18 inches long and 9 inches wide, and the joint was a double-bevel butt along an 18-inch edge. About 20 percent of the welds of the semi-rigid type of joint failed either at one end or both ends, without the application of a blow, and approximately the same percentage of one and two layer welds of the rigid type of joint failed between the ends, also without a blow.

(b) Four 18-inch diameter patches were welded in the heavy deck plate of the U. S. S. *Langley* at Norfolk. Double bevel butt welds were used and the morning after the welds were completed, one patch was found on the bottom of the bunker. On applying a sledge to the three others, two of these were immediately dislodged, the welds having completely failed. The fourth patch appeared to be satisfactory.

(c) Numerous double-bevel butt joints of battle towing target *No. 60,** which was constructed in 1919 at Norfolk, cracked during welding or subsequent to welding, many failing with a loud report, some of the cracks in 18-foot welds being 6 feet long. These joints were of both the rigid and fixed types. This target subsequently broke in two and had to be abandoned. Three more welded targets have recently been constructed at Norfolk (Fig. 4) and another one is now being built, in all of which, lap, tee and open butt-strap joints were used. No welds of these targets failed during construction, although the structure was rigidly assembled prior to welding and welds were simultaneously made in the most convenient location and no particular weld sequence adhered to.

(d) Bilge keels were welded on three ships at Norfolk (Fig. 5) and similar bilge keels on another ship at the Puget Sound Navy Yard. There were two keels forward and two on the after section of the ship. Each keel was of 20 pound ship plate, about 20 inches wide and was assembled in 3 or 4 sections, the sections being joined by a full continuous double-bevel butt weld (Fig. 3). They were attached to the shell plating of the ship with a straight tee joint (Fig. 1), with a full continuous fillet weld on each side. Some of the butt welds were made after the individual sections were welded to the shell. During the three years in which these keels have been in service, failure occurred in several butt welds of one of the ships welded at Norfolk and several of the butt welds of the ship welded at the Puget Sound Navy Yard. In both of these ships, two of their cracked butt welds extended into the shell plating of the ship (Fig. 6). In one instance, the shell plate was cracked as much as 27 inches above the keel and 8 inches below the keel, and in another instance, the total length of failure was 22 inches. The two other failures were 6 and 1½ inches respectively. The cracked shell plating was repaired by riveted butt straps and the cracked butt welds by welded straps, except those butt welds in which failure extended into the shell plating of the ship, these being repaired by a riveted strap. Straps were also welded on the butts of the keels of the other two ships and no failure has occurred to date, nor has any failure occurred in the tee welds on any of the ships.

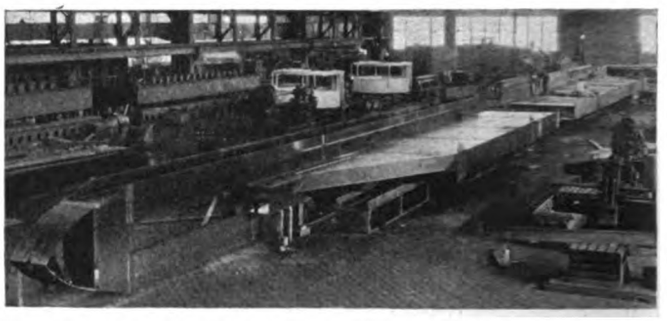

Fig. 4.—Metal Arc Welded Battle Towing Target Built at the Norfolk Navy Yard

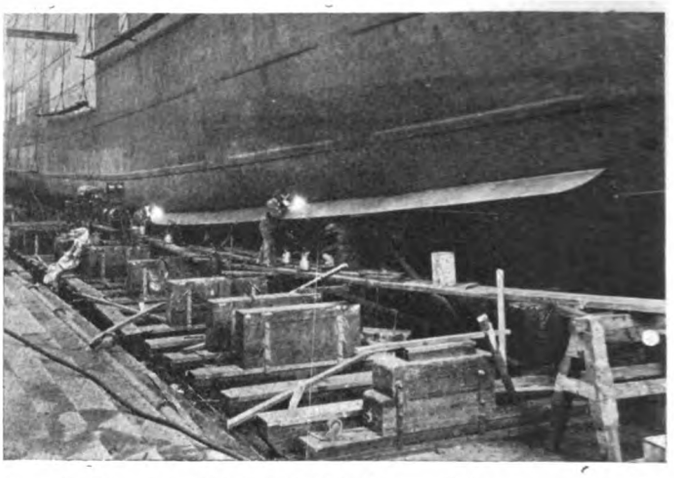

Fig. 5.—Bilge Keel Being Welded on a Ship at the Norfolk Navy Yard

(e) Joggled lap and butt strap joints were used on the British cross channel barge completed by the Admiralty in 1916, and lap, joggled lap, straight tee and butt strap joints on the British ship *M. V. Caria*, ex-*Fullagar*, launched on February 1920. Reports to date indicate that joints are in good condition.

Conclusions

The full strength of the plate cannot be taken advantage of in riveted construction, due to the fact that the maximum

*For a description of this job see "The Welding Engineer," December, 1920.

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efficiency of a riveted joint is only 89 percent, as given in the U. S. Navy Department's specifications, and that the seams open up at much lower efficiencies, permitting water to enter between the faying surfaces. If the non-rigid type of metal arc welded joint is used in the same class of material, an efficiency of 100 percent can be secured and joint is tight up to its ultimate strength.

It will not be very long before ship designers, and designers of structures in general, will be forced to recognize the great savings in weight of material, and costs of construction that are possible by means of metal arc welding, and that the welded structure is vastly superior to any riveted

Fig. 6.—Crack in Shell Plating of a Ship Caused by Failure of a Butt Joint in a Welded Bilge Keel

structure that can be built, as it can resist collision very much better, upkeep costs are reduced to a minimum and its life probably longer.

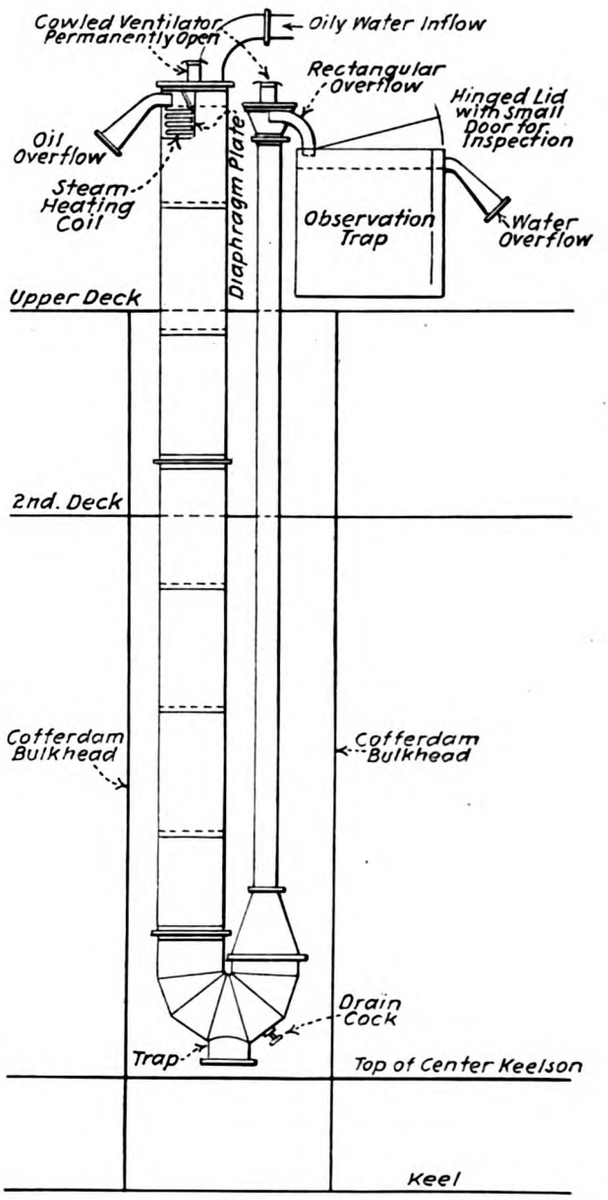
In order to secure the foregoing results, it is necessary for the designer clearly to understand the fundamental principles involved in the design of welded structures, foremost among which are the laws of residual stress.

Conduit Type Oil Separator

APPARATUS designed to prevent the oil pollution of harbor waters has been developed in the form of a conduit type oil separator for installation on all types of vessels where the separation of oil and water is required. This equipment has been patented in Great Britain by Messrs. Knight & Smith, Dunedin House, Basinghall avenue, London, E. C. 2. The accompanying diagram of the apparatus indicates the method of functioning.

The system consists principally of two vertical conduits connected at the lower end, the inflow side being larger than the outflow. The inflow conduit is provided with a diaphragm plate, steam heating coils and oil overflow. After filling with water, the oily ballast water is pumped into the inflow side, a corresponding quantity of water flowing from the outflow side into an observation trap and thence overboard or to a ballast tank. Oil is collected in the inflow conduit, passes the heating coils, which assist the separation and reduce the viscosity, and flows through the overflow pipe to a settling tank or bunker as may be desired.

In the case of vessels carrying oil in bulk, the apparatus would normally be fitted in a cofferdam but, if desired, various suitable alternative positions could be arranged. The oily ballast water from the main cargo tanks may be pumped



Diagrammatic Sketch of Conduit Oil Separator

through the conduit separator at the maximum rate of which the ship's pumps are capable, the oil being recovered and the water led overboard or to ballast tanks. By this means pumping out and separation may be done in port or during a voyage in ballast, considerable economies being effected, it is claimed, by saving the cost of (1) oil at present lost by being thrown overboard with ballast water, (2) delay in vessels entering ports due to the necessity for cleaning tanks at sea, and (3) vessels proceeding to sea to clean tanks.

In addition to its use in oil carrying vessels, this apparatus is suitable for oil burning vessels and motor vessels and in fact for all types of vessels in which the problem of the separation of lubricating and fuel oil and water arises.

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Water Rates and Steam Consumption of Auxiliaries-II*

Steam Consumed by Feed Pumps, Forced Draft Blowers, Fuel Oil Pumps, Oil and Water Heaters and Main Circulating Pump

By E. A. Stevens, Jr.,† and H. E. Brelsford‡

TO calculate the steam consumed by each auxiliary of this group, it is necessary to know the approximate amount of water evaporated by the boilers and that condensed in the condenser and the amount of fuel consumed. To determine the above, proceed as follows:

First: Obtain the steam consumption of the main engine or turbine.

Second: Obtain from Figs. 1 or 2 (published on pages 428 and 429 of the July issue) the approximate amount of steam required for the auxiliaries of the first group.

Third: Calculate the steam consumed by the various auxiliaries of the second group.

Type of engines—Twin screw, cross compound turbines with single reduction gear.
Total shaft horsepower (of two shafts) 12,000
Boiler pressure ..... 275 pounds, gage
Vacuum at turbine exhaust ..... 28 inches
Water rate of main turbine ..... 11 pounds
Steam consumption of main turbines ..... 132,000 pounds
Kind of fuel ..... Oil

The dimensions of the auxiliaries will be given with the examples.

The steam consumed by the auxiliaries of the second group, and that for the galley, pantry and heating and the

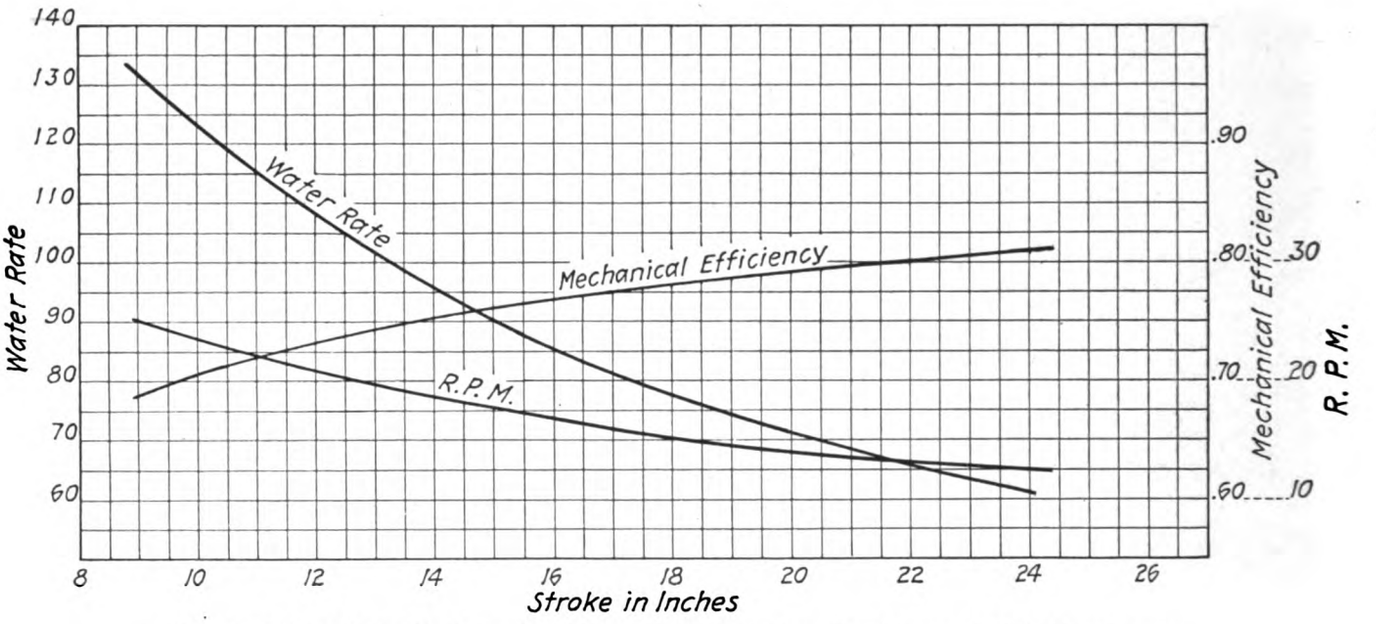

Fig. 4.—Water Rate, Mechanical Efficiency and Revolutions Per Minute of Main Feed Pumps

Fourth: Calculate the steam used in the galley and pantry and that required for heating the living quarters and water for baths, etc.

Fifth: Estimate the average amount of make-up feed water.

The calculations for the third, fourth and fifth items will be shown in detail later.

The water evaporated by the boilers will be the sum of the above, while the steam condensed in the condenser will be equal to the sum of the first, second and third items less the steam used in the feed water heater, fuel oil heater and evaporators, if the latter are operated. If the ship is fitted with an air ejector, the steam used by it is generally sent direct to the feed tank and not to the condenser, but no allowance need be made for this, as the degree of accuracy hardly warrants the complications. For this reason the steam used by the fuel oil heater need hardly be considered when computing the steam condensed in the condenser.

All of the examples given to illustrate the working of this method will be for a ship of the following characteristics:

make-up feed water have been calculated (as shown later) and are as follows:

Second group 12,500
Galley, pantry 610
Make-up feed water 5,400

From Fig. 2 (see page 429 of the July issue) it will be seen that the water rate of the auxiliaries of the first group (using 6,000 shaft horsepower as the power of one shaft) is 1.55 pounds. Then the steam consumed by these auxiliaries will be $12,000 \times 1.55 = 18,600$ pounds.

For extreme accuracy the steam used by the engine and fire room bilge pump and the lubricating oil cooling water pump, if the latter is used, should be calculated and added to the above but as this is less than 1.5 percent of the water evaporated by the boilers, it may be omitted until later.

The total water evaporated by the boilers will be $132,000 + 12,500 + 610 + 5,400 + 18,600 = 169,110$ pounds per hour.

Feed Pumps

Very often a gage is placed at the discharge of the pump which gives the total head in pounds per square inch due to the boiler pressure and the friction in the feed water heater

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pipes, etc. This pressure is, as a rule, about 40 pounds higher than the boiler pressure in most ships, where there is a regulator to the feed pump throttle, which is controlled by the level of the water in the feed tank. In ships where there is such regulation the pressure is about 75 pounds greater than the boiler pressure.

The suction head depends upon the location of the feed tank, the bottom of which generally is on a level with the engine room floor. When this is the case the suction head will be about enough to overcome the resistance of the valves. With this in view it would seem reasonable to take the total head, unless one has reason to do otherwise, as 40 or 75 pounds, as the case may be, greater than the boiler gage pressure.

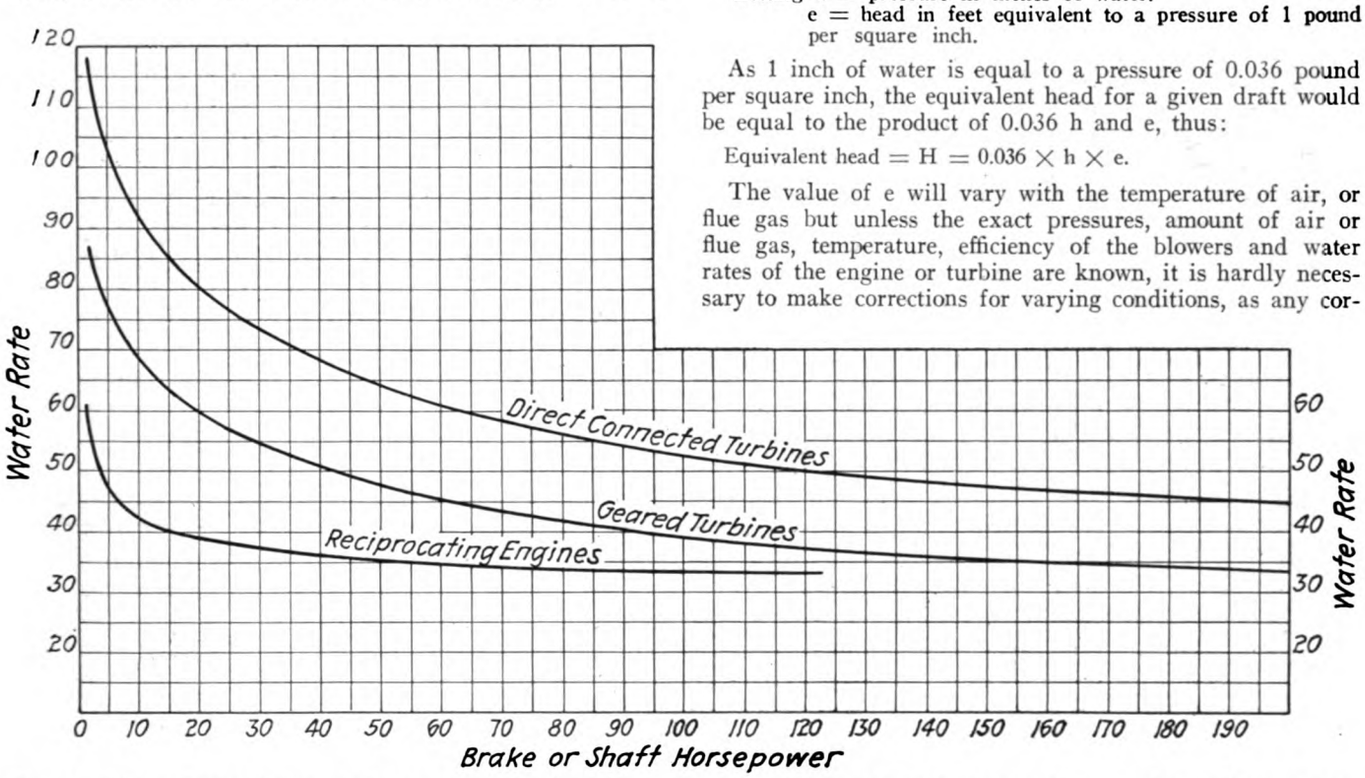

Fig. 5.—Water Rate of Forced Draft Blowers, Circulating Pumps and Centrifugal Condensate Pumps; Steam Pressure, 100 to 120 Pounds Gage; Back Pressure, 10 to 15 Pounds Gage

The equivalent head in feet (H) will be

H = (Boiler gage pressure + 40) × 2.31, when the feed pump throttle is regulated by the level of the water in the feed tank and H = (Boiler gage pressure + 75) × 2.31, when the feed is not regulated.

Letting W be the weight of water pumped in pounds *per minute*, we have

$$\text{Water horsepower} = \frac{W \times H}{33{,}000}$$

$$\text{I. H. P.} = \frac{\text{Water H. P.}}{\text{M. E.}}$$

Steam consumption in pounds per hour = I. H. P. × W. R.
M. E. = mechanical efficiency from Fig. 4.
W. R. = water rate from Fig. 4.

EXAMPLE

Assuming the feed pumps to be regulated by a float in the feed tanks, the discharge pressure will be 275 + 40 = 315 pounds. From Table 1 (see page 427 July issue) we find the head in feet equivalent to 1 pound per square inch to be 2.31 for fresh water. Therefore the equivalent head will be 2.31 × 315 = 728 feet.

The total water pumped = 169,110 pounds per hour.

$$\text{Water H. P.} = \frac{169{,}110 \times 728}{33{,}000 \times 60} = 62.2.$$

From Fig. 4 we find the mechanical efficiency = 0.81 and the water rate = 61. Then

$$\text{I. H. P.} = \frac{62.2}{0.81} = 76.8$$ and the steam consumption is 76.8 × 61 = 4,690 pounds per hour.

FORCED AND INDUCED DRAFT BLOWERS

As the air and flue gas pressures are measured in inches of water, it will be convenient to have this term appear in the formula for air or flue gas horsepower, which is equal to the product of the weight of air or flue gas (in pounds) handled per minute and the equivalent head in feet divided by 33,000.

Letting h = pressure in inches of water.
e = head in feet equivalent to a pressure of 1 pound per square inch.

As 1 inch of water is equal to a pressure of 0.036 pound per square inch, the equivalent head for a given draft would be equal to the product of 0.036 h and e, thus:

Equivalent head = H = 0.036 × h × e.

The value of e will vary with the temperature of air, or flue gas but unless the exact pressures, amount of air or flue gas, temperature, efficiency of the blowers and water rates of the engine or turbine are known, it is hardly necessary to make corrections for varying conditions, as any correction will have only a very slight effect on the final results. In view of what has just been said, the values of e may be taken in all cases as 1,950 for air and 3,720 for flue gas. Then the equivalent head will be equal to

0.036 × h × 1,950 = 70.25 × h for air and
0.036 × h × 3,270 = 134 × h for flue gas.

The air or flue gas horsepower will then be as follows:

$$\text{Air H. P. (for forced draft)} = \frac{70.25 \times h \times Wa}{33{,}000} = \frac{h \times Wa}{470}$$

$$\text{Flue gas H. P. (induced draft)} = \frac{134 \times h \times Wf}{33{,}000} = \frac{h \times Wf}{246}$$

h (for forced draft) = air pressure in inches of water at fan discharge.
h (for induced draft) = difference of pressure in inches of water between the fan suction and discharge.
Wa = weight of air in *pounds per minute*.
Wf = weight of flue gas in *pounds per minute*.

The values of Wa and Wf in terms of pounds of air or flue gas per pound of fuel may be taken as follows:

Air 23.8 for coal and 19.7 for oil.
Flue gas 24.68 for coal and 20.64 for oil.

The value of h may be taken as equal to the fire-room pressure in closed fire room systems and about 1 to 2½ inches higher than the pressure at the furnace fronts in closed ash pit systems.

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For induced draft h seldom exceeds ½ inch.

The efficiency of the blower fan varies from about 0.30 to 0.60 and average of 0.45 may be taken in most cases.

Letting the fan efficiency be called E; we have

$$\text{S. H. P.} = \frac{\text{Air (or flue gas) H. P.}}{\text{E}}$$

Fig. 5 gives three curves for water rates, the lower is for reciprocating engines, the middle one for turbines connected through gears and the upper one for direct connected turbines. As all of these curves are for full load conditions and as the blower outfit is, as a rule, designed for greater capacities than what is generally used, the water rates should be increased somewhat, as the economies fall off at lighter loads.

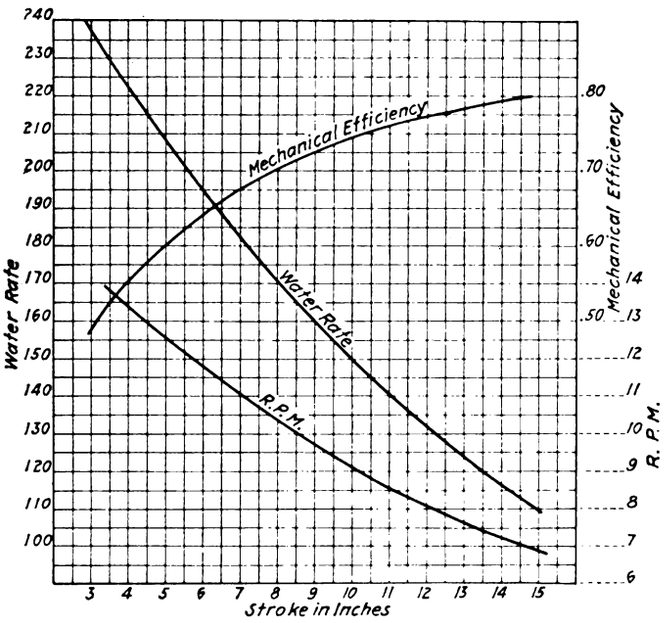

Fig. 6.—Water Rate, Mechanical Efficiency and Revolutions Per Minute of Fuel Oil Pumps

If the calculated shaft horsepower is used for obtaining the water rates, the latter should be increased as follows:

For reciprocating engines, corrected W. R. = W. R. × 1.15.
For turbines, corrected W. R. = W. R. × 1.30.
W. R. = Water rate from Fig. 5 when using the calculated

$$\text{S. H. P.} = \text{Air } \frac{\text{H. P.}}{\text{E}} \text{ for entering the chart.}$$

Thus, if the calculated S. H. P. is 5, the water rate and steam consumption would be as follows:

For reciprocating engine (one cylinder)
W. R. from Fig. 5 (for 5 S. H. P.) = 47.
Corrected W. R. = 47 × 1.15 = 54.1.
Steam consumption = 54.1 × 5 = 270.5 pounds per hour.

If a two cylinder engine is used, the water rate obtained from Fig. 5 would be that for a 2.5 horsepower engine which would be 54 pounds and the steam consumption would be

54 × 1.15 × 5 = 310 pounds per hour.

For a geared turbine.
W. R. from Fig. 5 (for 5 S. H. P.) = 76.4.
Corrected W. R. = 76.4 × 1.3 = 99.3.
Steam consumption = 99.3 × 5 = 496.5 pounds per hour.

For a direct connected turbine.
W. R. from Fig. 5 (for 5 S. H. P.) = 102.5.
Corrected W. R. = 102.5 × 1.3 = 133.3.
Steam consumption = 133.3 × 5 = 666.5 pounds per hour.

These curves are all for well designed units and, while the water rates as shown are not the lowest possible, they represent good practice. In some cases, especially with turbines, the water rates are considerably higher; with reciprocating engines they may be as much as 15 percent higher while with turbines the increase is, in some cases, as much as 25 percent.

After the turbine has been in operation for some time, the blades begin to erode, which causes an increase in the water rate, which will be as much as 50 percent in some very bad cases. As a rule it would be advisable to add, in addition to the allowances already given (namely 15 percent for reciprocating engines and 30 percent for turbines), about 5 to 10 percent for reciprocating engines and about 10 to 15 percent for turbines, to the calculated steam consumption, although this allowance is not made in the examples given to illustrate the method.

If an electric motor is used, its efficiency would be about 0.80 and, as there are 746 watts to one horsepower, the kilowatts necessary would be

$$\text{K. W.} = \frac{\text{Air (or flue gas) H. P.} \times 746}{\text{E} \times 0.80 \times 1{,}000}$$

$$\text{K. W.} = \frac{\text{Air (or flue gas) H. P.}}{\text{E}} \times 0.932$$

E = efficiency of the blower.

In order to obtain the approximate amount of fuel burnt, in order to obtain the amount of air or flue gas, so that the air or flue gas horsepower can be determined, the evaporation may be taken at 13.5 pounds of water per pound of oil and 8.5 pounds of water per pound of coal, or the fuel burnt per indicated horsepower or shaft horsepower may be taken at 1.1 pounds of oil and 1.7 pounds of coal.

Example

Water evaporated per hour = 169,110 pounds.
Type of draft, closed fire room.
Air pressure in fire room, 3 inches of water.
Blowers, number and type, 4 driven by direct connected turbines.
Kind of fuel, oil.

$$\text{Fuel oil burnt per hour} = \frac{169{,}110}{13.5} = 12{,}530 \text{ pounds.}$$

$$\text{Fuel oil burnt per minute} = \frac{12{,}530}{60} = 209 \text{ pounds.}$$

Air per minute = 209 × 19.7 = 4,120 pounds.

$$\text{Air H.P.} = \frac{\text{h} \times \text{Wa}}{470} = \frac{3 \times 4{,}120}{470} = 26.3.$$

$$\text{Total S. H. P. of 4 blowers} = \frac{26.3}{0.45} = 58.4.$$

$$\text{S. H. P. of one blower} = \frac{58.4}{4} = 14.6.$$

Water rate from Fig. 5 for 14.6 S.H.P. direct connected turbine = 85.7 pounds.
Corrected water rate = 1.3 × 85.7 = 112 pounds.
Steam consumption of all (4) blowers = 58.4 × 112 = 6,530 pounds per hour.

Fuel Oil Pump

The pressure of the discharge of this pump varies with the kind of oil used, the type of heaters and the layout of the piping. At low rates of combustion, such as are generally found on cargo ships, the average is about 150 pounds per square inch. At the higher rates, as generally used on passenger ships, an average of 210 pounds per square inch may be taken. The suction head, which varies with the height of oil in the settling tank, may be considered as being balanced by the friction through the suction pipe and strainers, and the resistance of the pump valves.

From Table 1 (see page 427 of July issue) we find that the head in feet equivalent to a pressure of one pound per square inch for fuel oil is 2.39. Then the total equivalent head in feet may be taken as the product of the discharge pressure in pounds per square inch and 2.39.

The steam consumption is obtained as follows:

$$\text{Oil H.P.} = \frac{\text{Wo} \times \text{H}}{33{,}000}$$

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Wo = oil pumped in pounds per minute.
H = equivalent head in feet.

$$\text{I. H. P.} = \frac{\text{Oil H.P.}}{\text{M.E.}}$$

Steam consumption in pounds per hour = I. H. P. × W. R.
M. E. = mechanical efficiency from Fig. 6.
W. R. = water rate from Fig. 6.

EXAMPLE

From the previous example we find that the approximate amount of fuel oil consumed per minute is 209 pounds. The pressure at the discharge of the fuel oil pump is assumed to be 210 pounds.

Stroke of fuel oil pump = 10 inches.

Find the steam used per hour for the fuel oil pumps.

Head = 210 × 2.39 = 502 feet.

$$\text{Oil horsepower} = \frac{209 \times 502}{33{,}000} = 3.18.$$

From Fig. 6 we find that the mechanical efficiency is 0.745 and the water rate is 150 pounds, then indicated horsepower = 3.18 ÷ 0.745 = 4.27 and the steam consumed per hour = 4.27 × 150 = 640 pounds.

FUEL OIL HEATER AND HEATING COILS

Nearly all ships burning oil carry most of the fuel in the double bottoms, the temperature of which is approximately equal to that of the sea. This oil is pumped to the settling tanks, where any water and other foreign matter is allowed to settle, before the oil is pumped to the burners. This oil has to be heated in order to be pumped and to get a good spray at the burners the temperature has to be raised to about 180 degrees F. This temperature depends upon the viscosity of the oil which should be reduced to about 4 Engler at the burner. The steam necessary to do this can be calculated by the following formula:

$$Ws = \frac{Wo \times (t_2 - t_1) \times S}{L}$$

Ws = pounds of steam per hour.
Wo = pounds of oil burnt per hour.
t_2 = temperature of oil at the burners in degrees F.
t_1 = temperature of oil in double bottom tanks in degrees F. This can be taken equal to the sea temperature.
L = latent heat of steam at the pressure used.
S = specific heat of fuel oil, which may be taken at 0.5.

If there were no radiation losses, the weight of steam as found by the above formula would be correct. Unfortunately this is not the case, as there is a large loss of heat into the sea; furthermore, as the water and other impurities settle quicker when the oil is hot than they do when cold, the settling tank is kept heated, which requires quite an amount of steam. With this in view an allowance should be made which will be called C. The formula then becomes:

$$Ws = \frac{Wo \times (t_2 - t_1) \times S \times C}{L}$$

Taking the value of S = 0.5 and C = 2 we have

$$Ws = \frac{Wo \times (t_2 - t_1)}{L}$$

The weight of steam thus obtained will be that required to heat the oil in the tanks as well as the steam used in the heaters.

EXAMPLE

From the example given under "Forced Draft Blowers," we have the oil burnt per hour (Wo) is 12,530 pounds. Assuming the sea temperature (t_1) to be 60 degrees F., the temperature of oil at the burners (t_2) 180 degrees F. and the steam pressure in the heating system at 100 pounds per square inch gage, we have

$t_2 - t_1 = 180 - 60 = 120.$

Latent heat at 100 pounds gage pressure = 880.

$$\text{Then } Ws = \frac{12{,}530 \times 120}{880} = 1{,}710 \text{ pounds per hour.}$$

FUEL OIL TRANSFER PUMP

As this pump is not in continuous operation, the total steam used by it during the day should be divided by 24 in order to obtain the average hourly consumption. As this amount is small, an allowance of 40 per cent of the steam consumed by the fuel oil pumps may be taken as the average hourly consumption.

EXAMPLE

Steam used by fuel oil pumps = 641 pounds per hour.
Steam used by fuel oil transfer pump = 640 × 0.40 = 256 pounds per hour, average.

FEED WATER HEATER

In order to approximate the steam condensed in the main condenser, it is necessary to know the amount of auxiliary exhaust steam used in the feed water heater. This can be found by the following formula:

$$Ws = \frac{Wf \times (t_2 - t_1)}{L}$$

Ws = auxiliary exhaust steam condensed in feed water heater in pounds per hour.
Wf = feed water pumped to boilers in pounds per hour.
t_1 = temperature in degrees F. of water in feed and filter tank.
t_2 = temperature in degrees F. of feed water after passing through heater.
L = latent heat in B.T.U's. per pound of auxiliary exhaust steam.

EXAMPLE

Wf = 169,110.
t_1 = 120.
t_2 = 225.
Auxiliary exhaust steam pressure = 10 pounds gage.
L = 952 B.T.U's.

$$Ws = \frac{169{,}110 \times (225 - 120)}{952} = 18{,}650 \text{ pounds per hour.}$$

MAIN CONDENSER

The weight of steam condensed in the main condenser will equal that used by the main engine and the auxiliaries of the first and second groups less that condensed in the feed water heater, fuel oil heating system and evaporators.

EXAMPLE

		Pounds per Hour
(1)	Steam for main turbines	= 132,000
(2)	Auxiliaries of first group from Fig. 2, 1.55 × 12,000	= 18,600
(3)	Auxiliaries of second group	= 12,500
(4)	= (1) + (2) + (3)	= 163,100
(5)	Steam used by feed water heater	= 18,650
(6)	Steam used for heating fuel oil	= 2,120
(7)	= (5) + (6)	= 20,770

Steam to condensers = (4) − (7) = 163,100 − 20,770 = 142,330 pounds per hour. As there are two condensers, the steam to each will be 71,165 pounds per hour or 1,186 pounds per minute.

MAIN CIRCULATING PUMP

As the total heat units absorbed by the circulating water equal that given up by the condensed steam, the formula for the weight of circulating water pump per minute will be

$$W = \frac{Wc \times L \times C}{t_o - t_i}$$

W = circulating water in pounds per minute.
Wc = steam condensed in pounds per minute.
t_i = temperature in degrees F. of main injection.
t_o = temperature in degrees F. of overboard discharge.
C = constant, to allow for the heat given up by the condensate and air in the condenser which will be, as a rule, about 1.035.

The total head will depend upon the design of the condenser. To determine this accurately the reader is referred

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to "Vacuum and Condensers" by G. L. E. Kothny in "Marine Engineer's Handbook" by F. W. Sterling. If no part of the condenser or its piping is above the waterline, the static head on the discharge side will be balanced by that of the suction and in such cases the total head will be due entirely to friction, which, in most cases, can be taken at 20 feet. If the overboard discharge or any part of the condenser or its piping is higher than the waterline, the difference between this height and the waterline should be added to the friction head.

The water horsepower will be

$$\text{Water H.P.} = \frac{W \times H}{33{,}000}$$

W = circulating water in pounds per minute.
H = head in feet (usually about 20 feet).

The efficiency of circulating pumps varies considerably, but a fair average would be as follows:

Kind of drive	*Efficiency E*
Reciprocating engine	0.65 to 0.70
Geared turbine	0.60 to 0.65
Direct connected turbine	0.55 to 0.60

The shaft horsepower will be

$$\text{S. H. P.} = \frac{\text{Water H.P.}}{E}$$

The above efficiencies may be considered low, but it would not be advisable to use higher values, unless the characteristics of the pump are known, as there would be, in so doing, the danger of underestimating the steam consumption.

The water rates are obtained for the engine or turbine from Fig. 5 in the same manner as explained under "Forced and Induced Draft Blowers." Then

Steam consumption in pounds per hour = S.H.P. × W.R. × c
W.R. = water rate from Fig. 5.
c = 1.15 for reciprocating engines.
c = 1.30 for geared and direct connected turbines.

EXAMPLE

Steam condensed per condenser, 1,186 pounds per minute.
Temperature of main injection in degrees F. = t_i = 60.
Temperature of overboard discharge in degrees F. = t_o = 80.
Vacuum, 28 inches. Latent heat per pound of steam, 1,035 B.T.U.
Head = 20 feet; $t_i - t_o = 80 - 60 = 20$.

Circulating water *per minute* per condenser $= \frac{1{,}186 \times 1{,}035}{20} \times 1.035 = 63{,}500$ pounds.

Water H.P. for one pump $= \frac{63{,}500 \times 20}{33{,}000} = 38.5$.

If a direct connected turbine is used, the pump efficiency would be from 0.55 to 0.60; take 0.58.

S.H.P. (of one pump) $= \frac{38.5}{0.58} = 66.4$.

Water rate from Fig. 5 (for S.H.P. = 66.4) = 59.
Corrected water rate = 59 × 1.3 = 76.7.
Steam consumption, both pumps = 2 × 66.4 × 76.7 = 10,190 pounds per hour.

If a two cylinder single expansion engine was used, the S.H.P. and steam consumption would be as follows:
Pump efficiency assumed to be 0.67.

S.H.P. of one pump $= \frac{38.5}{0.67} = 57.5$.

S.H.P. of one cylinder $= \frac{57.5}{2} = 28.8$.

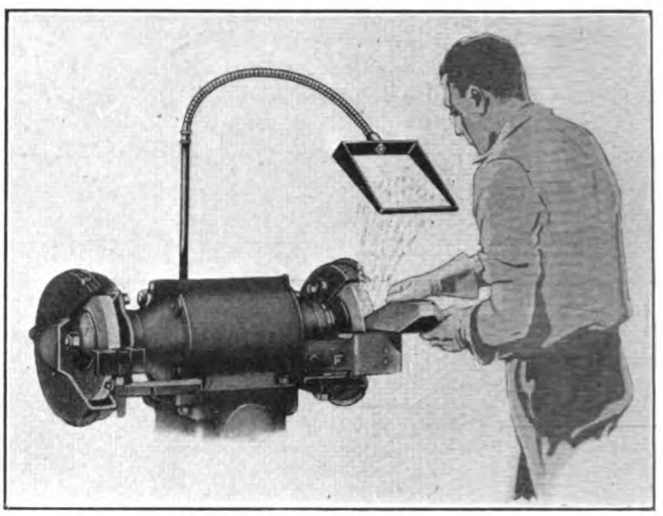
Water rate from Fig. 5 (for 28.8 S.H.P.) = 37.7 pounds.
Corrected water rate = 37.7 × 1.15 = 43.4 pounds.
Steam consumption of one pump engine = 57.5 × 43.4 = 2,500 pounds per hour.
Steam consumption of both pump engines = 2,500 × 2 = 5,000 pounds per hour.

(To be continued)

Eye Shield for Grinding Machines

THE ACME eye shield, shown in the accompanying illustration, has been developed by the Dreis & Krump Manufacturing Company, 74th street and Loomis Boulevard, Chicago, to eliminate the necessity of grinding wheel operators wearing goggles and to reduce eye accidents.

Various arrangements are provided for attaching the shield to grinding machines; either by bolting the standard to the base of the grinder, tapping into the grinder frame or attaching it to an adjacent post or wall. The glass used in the shield is non-scatterable glass, which not only prevents particles of emery or steel from getting in the workman's eyes but also protects the face and head in the event of larger objects striking the glass. The glass will not scatter when struck with sufficient force to crack it. The size of the glass is 7 inches by 9 inches, which is ample for all requirements.



Eye Shield for Protecting Grinder Operators

The shield is mounted in a steel frame and can be readily replaced. The flexible arm to which the frame is attached allows instant adjustment to the front or side of the wheel and to any convenient height. The shield can be used to cover both wheels if belt guards do not obstruct the movement of the arm. The shield is furnished complete with adjustable steel brackets, an 18-inch length of pipe, floor flange, street elbow, nipple, lock nuts, 18-inch flexible arm, steel frame and 7-inch by 9-inch non-scatterable glass.

Factors in Seaworthiness

THE breach of the implied warranty of seaworthiness goes to the very essence of the marine contract and voids the entire transaction. It is a most interesting question to underwriters because of the many peculiar conditions that surround it. Seaworthiness, according to the authorities, not alone implies that the vessel be staunch and sound but that she be also properly manned. There are surprising illustrations of this. For example, take the case of the *Rio de Janiero* (130 Fed. 76), in which the court of appeals held that the vessel was unseaworthy when she sank in the Golden Gate for the reason that her crew was composed of Chinese who could not speak English, so that when an emergency arose they were unable to understand the orders of the master and first officer.

In a more recent decision it was held that as to the sailors aboard, who were suing for injuries received, a vessel was unseaworthy because of the extreme cruelty of the first mate.

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Questions and Answers Relating to Naval Architecture and Marine Engineering

Conducted by James L. Bates, Naval Architect, and W. B. Newton, Marine Engineer

This department is maintained for the purpose of answering all questions relating to ships and their machinery. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

Machinery Fastenings

Q. (1,263).—What is the best method of fastening the main and auxiliary machinery to the structural foundations of the hull. Should any "chocks" or "packing" be interposed between the bottom of bed plate and top of foundation, or what other method be used? While I wish the above for ships of various sizes, a special case arises on a small vessel, with about a 125 horsepower 4 cylinder Diesel engine. This engine is to be supported by two (one port, one starboard) cast steel girders of "channel" section, about 10 inches deep forward and 4 inches deep aft. These girders are supported by longitudinal structural girders to the shell. In what manner should the engine be fastened to the cast steel girder?

A. (1,263).—In the case of auxiliary machinery in which heavy reciprocating stresses are experienced, it is not believed best to secure the bed plates of the same to their foundations by holding down bolts alone. In order to insure the maintaining of an accurate alinement, bed plates should be fitted to their foundations by true surfaces and in addition to the holding-down bolts should be secured by rectangular or tapered keys or by chocks so fitted as to relieve the holding-down bolts from shearing stresses. The design of the bed plate should provide sufficient thickness of material in the way of keys, if the same are to be used.

In placing heavy Diesel engines of large size it is practice to fit horse shoe liners between the engine bed plate and foundation girder and to chock up between liners with oak wedging.

In the latest practice for high speed Diesel engines of moderate power a continuous metal liner is fitted between the engine bed plate and the foundation casting and small cast steel chocks are bolted to the foundation girder and given a machine fit against the engine bed plate so as to prevent lateral motion.

Stern Tube Fitting

Q. (1,264).—Should any "gaskets" or "packing" be used between the collar on the stern tube and the forward face on the stern frame, and the after face of the stern frame and the nut? If any, what kind?

A. (1,264).—It is practice to cast the stern tube with a shoulder which brings up against the forward side of the stern frame forging. The after end of the stern tube casting is fitted to receive a nut which is turned up tight against the rear face of the stern frame forging, no gaskets or packing being used in either case.

Percentage Completion of Vessels

Q. (1,266).—In what manner does the Navy determine the percentage of completion of a vessel, involving hull, machinery and house?

A. (1,266).—In naval practice a report of progress for each vessel is forwarded monthly to the department. The basis for this report is an approved schedule for payments in which the estimated weights of the groups, such as framing, bulkheading, anchor handling gear, etc., have been tabulated and unit costs per pound agreed upon with the contractor. A careful system of weighing all material actually worked into the ship is followed. The percentage of progress reported is based on the estimated money value of the ship according to the approved schedule for payments, the total estimated value of the ship being taken as 100 percent.

In order to provide for proper adjustments in connection with authorized changes or unforeseen delays, careful records are kept of all changes and their effects both upon weight and cost, and reports are promptly submitted relative to any claims for delays.

How to Stiffen a Boat Davit

Q. (1,271).—I desire to hoist one ton on each of two boat davits of the solid round section type at an overhang of 3 feet 9 inches. At the present time my davits are 3 inches in diameter, with a 3-foot overhang, having been intended for handling a small dinghy. I intend to obtain my increased overhang by the strut arrangement shown in Fig. 2. Do you think my scheme for stiffening the present davits is satisfactory?

A. (1,271).—The stiffening scheme you propose is cumbersome, difficult to fit and ineffective as a strengthening device. The maximum bending moment on the boat davit

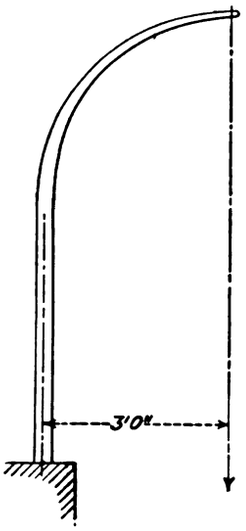

Fig. 1

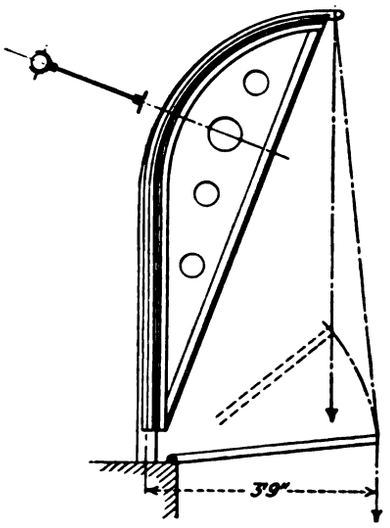

Fig. 2

as shown in Fig. 2 occurs at the deck. This is below or at the point where your proposed scheme of stiffening ends.

I would suggest that a solid circular section davit of increased diameter would be more satisfactory and little, if any, more expensive than the combination you show in Fig. 2.

If such a davit be made of 60,000-pound steel and designed for a working load of 2,000 pounds at an outreach from its centerline of 3 feet 9 inches with a working stress of 14,000 pounds per square inch, the diameter would be about 4 inches. No struts would be required and you would have a ship shape job. Of course, such a davit will require a new deck casting and perhaps a new step. It may be that local stiffening underneath the deck will be necessary. The formula by means of which the above diameter has been obtained is as follows:

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$$d = 0.09 \sqrt[3]{M}$$

In which

d = diameter of a solid circular section davit in inches.
M = bending moment in inch pounds.

All for an assumed stress of 14,000 pounds per square inch.

Flush Deck Type of Destroyer

Q. (1,267).—What are the specifications of the so-called flush deck type of destroyer? Have they bilge keels, if so of what type and dimensions?

A. (1,267).—The so-called flush deck type of destroyer had its inception in a desire to secure an adequate depth of ship girder without sacrificing the accommodations which had been obtained in the previous classes of destroyers built with forecastles. The first vessels of this type were those of the *Manley* class.

All modern United States destroyers are fitted with bilge keels. These consist of a 12 by 5 by 5-inch by 31.5-pound I-beam with the outward flange removed by cutting through the web of the beam as close to the flange as is practicable. This leaves a section of an elongated T-bar type. The keels are fitted in as long lengths as practicable, having a total extent of about one-third the length of the ship and are carefully double bosom strapped at the butts.

Absorption of Air in Water

Q. (1,272).—About how much air, either by weight or volume, is contained in a given amount of water? Also, what is the action of air in heating and drying systems? Assume that we have a laundry dryer which requires a 10 horsepower boiler to operate, and that the dryer has been shut down for the night, and, as a consequence, the coils have become air bound, do you think, if this dryer was purged of air in the morning when starting up, that the steam entering would contain enough air to interfere with the operation of the dryer? Also suppose that, due to favorable conditions, such as higher outside temperature, better laundry, etc., the dryer was using, say 75 per cent of the 10 horsepower boiler, do you think there would be any noticeable difference in the operation of the dryer due to less air coming in with the steam then than when the dryer was operating at its rated capacity?

A. (1,272).—While many writers on engineering subjects refer to the air contained in boiler feed water, few attempt to give any quantitative value for its content. Such information as is available is not in very close agreement.

The Smithsonian Physical tables give the following absorption coefficients of air (by volume) measured at 0 degrees Centigrade and at atmospheric pressure for different temperatures of water:

Temperature of Water, Degrees Centigrade	Temperature of Water, Degrees Fahrenheit	Absorption Coefficient
0	32	0.02471
5	41	.02179
10	50	.01953
15	59	.01795
20	68	.01704

The following is given by Mr. G. J. Foran for Winkler's data as the amount of dry air at atmospheric pressure absorbed by one cubic foot of water at various temperatures:

Temperature of water, Degrees Fahrenheit	Absorption coefficient, cubic feet of air per cubic foot of water
52	0.0217
72	.0162
92	.0141
112	.0125
132	.0105
152	.0085
172	.0065
192	.0039
212	0.0

It will be seen that the absorption coefficient decreases rapidly with an increase in temperature and vanishes at the boiling point. Orrok gives 4.3 percent (by volume) for Croton water and Mr. Thomas C. McBride, in a paper on "Air Leakage in Steam Condensers" before the American Society of Mechanical Engineers, June, 1908, assumed 1½ percent (by volume) as the air content of feed water.

The action of air in the coils of a heating or drying system is similar to that of air in a steam radiator. In consequence of its greater density, the air collects in the lower levels of the coils and, if not removed, must be forced along by the incoming mixture of steam and air. This action retards the flow of steam and lowers the efficiency of the installation.

In order that the dryer may operate at the highest efficiency, a fundamental requisite is that the coils must not be permitted to become either water-bound or air-bound. It appears, however, that, if the air is removed from the coils before starting up in the morning, little trouble need ordinarily be anticipated in the course of a day's run. However, a more frequent removal of the air would add to the efficiency of operation.

If the dryer is operated on a reduced capacity of the rated boiler horsepower, due to the more favorable operating conditions you mention, a saving of fuel will obviously result, since a lesser quantity of water need be converted into steam. The ratio of air to steam passing through the coils will remain unchanged and it is doubtful whether any difference in the operation of the dryer will be noticeable.

Stud Vs. Open Link Anchor Chain

Q. (1,268).—Which is the stronger—an anchor chain with a stud in the middle, or one without a stud?

A. (1,268).—From the standpoint of ultimate strength there is no difference. The following figures are quoted from the current specifications of the United States Navy Department for wrought iron chain cable of moderate size:

	Size, Inches	Weight, Pounds Per Fathom	Proof Stress, Pounds	Breaking Stress, Pounds
Stud link	1½	133.0	84,000	140,000
Open link	1½	134.5	63,000	140,000

Note that while the breaking stress is given as 140,000 pounds in each case the proof stress is much higher for the stud link than for the open link. In other words the stud link chain may be subjected to higher stresses in service without beginning to show deformation than can the open link. On this account a stud link cable should have a greater length of service than the open link before being condemned because of stretch or other link deformation.

One of the principal advantages of the stud link as compared with the open link is that it prevents the cable from kinking.

LETTERS TO THE EDITORS

Ship Displacing 18,000 Tons Lifted in 10,000-Ton Floating Dry Dock

New York.

To the Editors:

In the June number there appeared an article describing the feat of lifting a ship displacing 15,900 tons on a 15,000-ton floating dry dock. The experience is interesting in many ways and should be welcome by people in charge of the operation end of the shipping business.

A case which also presents an interesting side to the marine man is that which occurred to the writer shortly after he became connected with the Lloyd Sabaudo Steamship Company in New York as consulting engineer.

The passenger liner *Conte Rosso* arrived with a propeller blade missing and it was absolutely necessary to have it replaced within the sailing date. On account of the mishap the ship was one day late, so that the usual six day stay in New York was further reduced to five days, in which time

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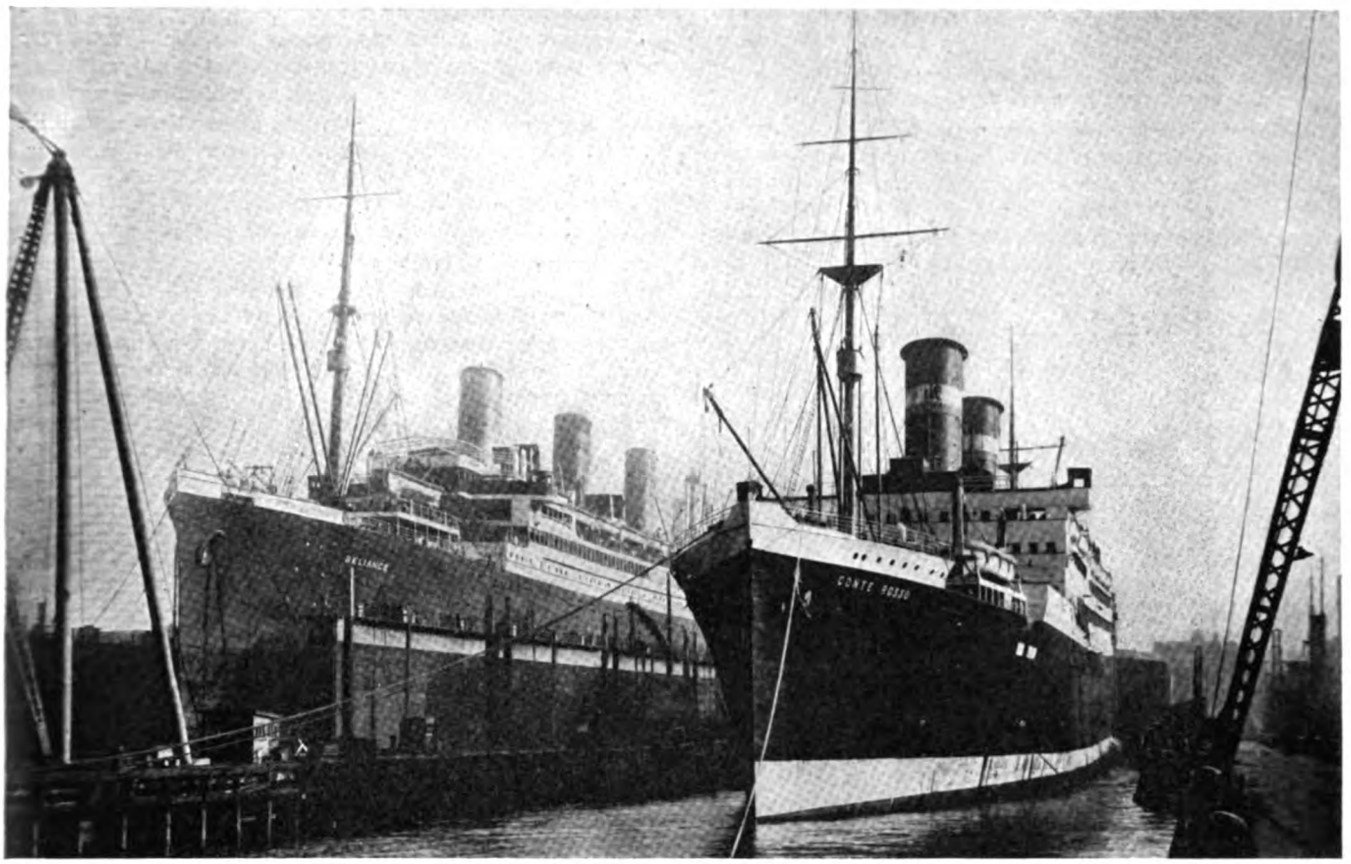

S. S. Conte Rosso, of 18,017 Gross Tons, Backing Into No. 1 Dry Dock at the Plant of the Morse Dry Dock and Repair Company, Brooklyn, N. Y. To the Left Is the S. S. Reliance, of 16,798 Gross Tons, in No. 2 Dry Dock

she had to discharge about 800 tons of cargo and load about 1,500 tons, besides taking 3,200 tons of fuel oil and 1,600 tons of water.

The only dry dock in New York harbor capable of lifting the *Conte Rosso* is the No. 2 floating dry dock of the Morse Dry Dock and Repair Company, the other floating or graving dry docks being unfit on account of lifting power, dimensions, or draft. This particular dock was at the time occupied by the passenger ship *Reliance* undergoing repairs to the stern frame and could not be made available within a week.

The case seemed to be hopeless, yet the writer, who during the war had many such problems to solve, was unwilling to give in, and therefore cast about for a solution. After a wide survey of the situation I made up my mind that it might be possible to use the No. 1 Morse dry dock by properly trimming the ship and conditioning the dock. Mr. Kelly, naval architect for the Morse Company, was consulted and found very willing to collaborate in solving the problem. Inside of a few hours the plan was completely worked out to the effect that the ship should be trimmed to a 23-foot even draft, the keel blocks on the dry dock removed and the ship lifted enough to have the blade out of the water.

The greatest difficulty was encountered in trimming the ship to the stated draft, as, when empty, the trim is considerably by the stern and we could use only the foremost double bottoms and the fore peak tank, otherwise we would have added too much weight for a very small lift of the stern. We could not use the inbound cargo as ballast to trim the ship, because the 800 tons were distributed in four holds and the part of it that was in the first two holds was not enough; on the other hand not enough outbound cargo was ready to be put in.

Finally we got 600 tons of cargo which we placed in holds No. 1 and No. 2 and, after emptying all the double bottom tanks aft of No. 5 and all the boilers, the ship floated to the 23 feet draft calculated. The drydocking was a success in every way and the ship sailed at 3 o'clock sharp of Saturday afternoon as scheduled.

The *Conte Rosso* is a liner of 18,017 gross tons, 590 feet in length by 74 feet beam, displacing about 18,000 tons at 23 feet draft. The No. 1 Morse dry dock is 475 feet long by 126 feet wide over all and 90 feet inside and can lift 10,000 tons on a maximum draft of 22 feet over the blocks.

GIAN CARLO ZILIOTTO.

Length of Rope Stowed on Reel

NEWARK, N. J.

TO THE EDITORS:

The writer read with unusual interest the matter discussed under the above heading on page 373 in the June issue and having developed formulas on this subject simplifying to some extent the old rules used for determining the length of rolled up belts and coils of rope, etc., he applied himself to this formula and believes he has a simpler formula than given in this discussion particularly for rope that is carefully arranged on a reel as indicated in the sketch in the June number. When a rope winds on anything it naturally assumes the more carefully arranged position, particularly if the rope is taut, and therefore the writer would consider the last formula given in the June issue as more accurate than the formulas taken from the publications of the American Engineering Company, or Hughes' "Handbook of Ship Calculations, Construction and Operation."

My formula is as follows:

$$0.3\ (h + s)\ \frac{hL}{d^2} = \text{length in feet.}$$

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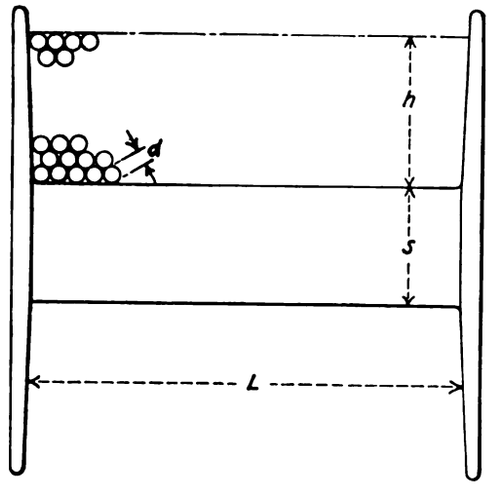
Where h = the depth of rope on the reel in inches as indicated in my sketch herewith;
s = diameter of shaft in inches;
L = inside length of reel in inches;
d = diameter of rope in inches.

This formula the writer believes to be the maximum of simplicity both as regards the number of dimensions and measurements to be made and the mathematical work required to solve any problem.

In the sketch in the June number an error was evidently made by the draftsman in showing the length "L" as the



Sketch of Reel Showing Dimensions Used in Formula

outside distance rather than the inside length of the reel. "L" naturally should be the inside length—not the outside length—because rope can occupy only the inside space.

W. F. SCHAPHORST, M. E.

NEW BOOKS

PRINCIPLES OF FOREIGN TRADE. By C. E. Griffin. Size, 6 by 8¾ inches. Pages, 348, including index. New York, 1924: The Macmillan Company.

This book gives a clear presentation of the economic principles underlying foreign trade. Business men, traders and students will find in this work a valuable summary of the many and diverse principles and problems involved in international commerce.

BOILER CHEMISTRY AND FEED WATER SUPPLIES. By J. H. Paul. Size, 5¾ by 8¾ inches. Pages, 252, including index. Diagrams, 25; illustrations, 2. London and New York, 1923: Longmans, Green & Company.

The chemical reactions which take place in a steam boiler and their effect upon operation and maintenance are taken up in this compact but comprehensive work. So far as possible technical language and expressions have been avoided with the result that the book will be found of immediate practical use by steam engineers, even though their knowledge of theoretical chemistry may be very limited.

THE ENGINEERING INDEX, 1923. Size, 6½ by 9½ inches. Pages, 700. Published by the American Society of Mechanical Engineers, New York.

This volume is the fifth to be issued since the American Society of Mechanical Engineers acquired the Index from the Engineering Magazine Company and assumed the continuation of a service first started forty years ago by the Association of Engineering Societies. The periodicals, reports and other publications reviewed in the Index were received through the Engineering Societies' library.

JANES FIGHTING SHIPS. Edited by Oscar Parkes, O.B.E., M.B., Ch. B. and Francis E. McMurtrie, A.I.N.A. Size, 8¼ by 13 inches. Pages, 401. Illustrated. London, 1923: Sampson Low, Marston & Company, Ltd.

No drastic changes have been made in this, the twenty-sixth, edition of "Fighting Ships," the book having been developed along the lines laid down a year ago. The ratification of the Washington Naval Treaty has resulted in the removal of a large number of capital ships from the sections of the Powers concerned. One class of ships to which greater attention has been paid in the present volume is that of aircraft carriers. Wherever changes have been made in major ships or in types, new photographs have been incorporated in the book.

MERCHANT SHIPS OF THE WORLD. Edited by Frank C. Bowen and F. J. N. Wedge. Size, 10 by 12½ inches. Pages, 492. Illustrated. London, 1923: Sampson Low, Marston & Company, Ltd.

This book is an illustrated descriptive annual of the world's merchant ships and has been designed by the editors to supplement the information contained in other naval manuals and in Lloyd's Register. The first part of the book gives the fullest available description of every merchant ship afloat with a registered tonnage of over 1,000 tons, while the second section is devoted to the identification of these ships at sea. The descriptions contained in the second part include the general characteristics of the vessels, with distinguishing marks, such as funnel stripes, colors and the like. Among the general details given are the date of commission of each vessel, the gross tonnage, displacement, deadweight tonnage, the net cargo capacity, load draft, number of winches and derricks, sea speed, indicated horsepower, fuel consumption and capacity, passenger accommodations, number of holds, the number and size of hatches, the length of the ship, the rise of floor, the type and power of wireless equipment and details of engines and boilers.

AN INVESTIGATION OF THE FATIGUE OF METALS. Bulletin No. 142. By H. F. Moore and T. M. Jasper. Size, 6 by 9 inches. Pages, 88. Illustrations, 22. Urbana, Ill., 1924: Engineering Experiment Station, University of Illinois.

Bulletin No. 142 of the Engineering Experiment Station of the University of Illinois is the third report of the progress of an investigation of the fatigue of metals carried on at the University of Illinois in cooperation with the National Research Council, Engineering Foundation, and several manufacturing firms.

This report covers tests with two nickel steels, ingot iron, steels containing 0.045 to 1.20 percent carbon, copper, brass, bronze and monel metal. Steel that had already been subjected to ten million or more cycles of stress at or near the endurance limit was retested to determine the effect of the original stressing. Tests were also made to determine the effect on the static strength and ductility of steel of ten million cycles of reversed axial stress at or near the original endurance limit; on the length of "life" of steel of stressing above the endurance limit; and on the endurance limit of overstressing and subsequent heat treating. Chemical analyses, static and impact tests were also made and hardness was measured. Additional evidence of the existence of an endurance limit for wrought ferrous metals was secured. As the result of experimental study made at the laboratory of this investigation as well as at other laboratories, an extension and modification of the well-

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known theory that fatigue failures in metal start from slip planes within the crystalline grains is presented in this bulletin.

Copies of Bulletin No. 142 may be obtained without charge by addressing the Engineering Experiment Station, Urbana, Illinois.

PERSONAL MENTION

A. G. HEINSOHN has been appointed assistant general passenger agent of the New York & Cuba Mail Steamship Company (Ward Line).

DAVID T. WARDEN has resigned as marine superintendent of the Tide Water Oil Company to go into the ship brokerage business with Walter H. Sieling.

R. C. HIGGINS has been appointed general traveling passenger agent of the Cunard and Anchor lines, succeeding J. W. Coupland, who has resigned.

CHARLES F. FORNASON, who graduated from the Nautical School Ship *Ranger* in 1911, has been appointed assistant inspector of hulls, with headquarters at Albany, N. Y.

LIEUT.-COMMANDER H. H. NORTON, commanding officer at the Fuel Oil Test Plant at Philadelphia, and who has been largely responsible for the success of the fuel oil school conducted at this plant for merchant marine officers, has recently been assigned to Asiatic service. On the way to his new post, Commander Norton will spend some time at San Francisco to assist in establishing a similar school at the Mare Island Navy Yard for the training of engineers on the Pacific Coast. Probably the greatest reason for Commander Norton's success at the fuel school has been his thorough understanding and appreciation of the men who have come to him for training. The experience he has gained in conducting the work at Philadelphia will be valuable in organizing the new fuel school at Mare Island, California.

Lt. Comdr. H. H. Norton, U. S. N.

L. R. HOLMES, manager of the Philadelphia offices of Furness, Withy & Company, is to succeed O. G. Hempstead, who recently died, as director of the Philadelphia Maritime Exchange.

W. L. SULLIVAN has been appointed representative of the Diamond Power Specialty Corporation of Detroit, Mich., for the state of Oklahoma with headquarters at 505 Central National Bank Building, Tulsa, Okla.

R. H. JONES, who served during the war as first assistant engineer on the steamship *Leviathan* and later joined the marine department of the Standard Oil Company of New Jersey, in the operations division, has been placed in charge of the marine department of the Tide Water Oil Company, succeeding David T. Warden, resigned. Mr. Jones is a graduate marine engineer and in addition has an unlimited license as master of steam vessels. He has had considerable experience both as chief engineer and master of vessels at sea.

JOSEPH E. SHEEDY, vice-president of the Emergency Fleet Corporation, in charge of operations, has been appointed general director for Europe of the government's shipping agencies and of the United States Lines by President L. C. Palmer of the Fleet Corporation. In making the announcement of this transfer, President Palmer emphasized the importance of coordinating under one head the European interests of the Fleet Corporation and those of the United States Lines. Mr. Sheedy has been connected with shipping and shipbuilding enterprises since his graduation from the Massachusetts Nautical Training School in 1903. He served as a commissioned officer in the Revenue Cutter service for six years, resigning in 1901, when he became general superintendent with the Inter-Island Steam Navigation Company. He remained with this company for five years and then assumed the duties of assistant to the general manager of the Seattle Construction & Dry Dock Company. He has also been general manager of the Seattle North Pacific Shipbuilding Company, assistant to the president and general manager of the Downey Shipbuilding Company, and, in September, 1921, European manager for the Emergency Fleet Corporation. Later he was made vice-president of the Emergency Fleet Corporation and has been in charge of operations until this new appointment.

Joseph E. Sheedy

OBITUARY

BENJAMIN G. LAMME, chief engineer of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., and a well-known electrical genius and inventor, died on July 8, at East Liberty, Pa., after an illness of several months. Mr. Lamme, who was born 60 years ago on a farm near Springfield, Ohio, was a pioneer in the field of electricity and was the designer of many of the standard types of generators and motors in use today. He became associated with the Westinghouse interests in their infancy and for many years served as chief engineer. About 150 inventions are credited to Mr. Lamme, including the umbrella type generator, used at Niagara Falls, the high tension system of power transmission and the synchronous converter, employed notably on the subway systems of New York for changing alternating to direct current. During the war, Mr. Lamme served as one of the two members of the American Institute of Electrical Engineers on the Naval Consulting Board and was chairman of the invention committee of the board.

B. G. Lamme

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The Month's Shipping and Shipbuilding News in Brief

Shipyard, Steamship and Port Activities and Other Notes of Interest in All Branches of the Marine Industries

New Ship Contracts Abroad; Others May Be Placed in America

ACCORDING to reports in marine circles recently, contracts have been placed abroad for two ships for the Gulf Refining Company and two for a West Indies fruit company. Whether or not either of the companies concerned will place any construction work in American yards, is not officially known, although the firm of Kindlund & Drake, naval architects of 17 Battery Place, New York, recently took bids for the building of several tank steamers for the Gulf Refining Company, and it has been understood for some time that the United Fruit Company would build one or two ships in American yards. Officials directly concerned with both companies were out of town and the report could not be officially confirmed.

Lumber Steamer to be Overhauled; General Engineering Co. Low

WITH a price of $17,464 and 21 days' time, the General Engineering & Drydocking Company submitted the lowest proposal for the reconditioning of the steamer *Frank D. Stout*, owned and operated by the California and Oregon Lumber Company in the coastwise lumber trade, at the opening of bids on July 8. The following tenders were submitted:

General	$17,464 and 21 days
Moore	18,145 and 24 "
United Engineering	19,450 and 23 "
Hanlon	19,642 and 25 "
Bethlehem	19,800 and 23 "

August 18 Set as Definite Date for Bids on Three Dipper Dredges

The bid opening date has been definitely set for August 18, 1924, by United States Engineer Office, Louisville, Ky., for constructing and delivering three dipper dredges, one without machinery for Nashville Engineer district for use on Cumberland River, delivery to be made at Paducah, Ky., and two dredges with all machinery for Louisville Engineer district with delivery at Louisville.

Bids to Be Taken August 15 for Steel Towboat

Sealed proposals will be received by the United States Engineer Office, Montgomery, Ala., until 11 A. M., August 15, 1924, and then opened, for constructing and delivering one 134-foot steel-hull stern-wheel towboat.

Government Planning Resumption of Shipbuilding with Expenditure of More Than Eight Millions

RESUMPTION of shipyard activity is seen in the announcement of the allocation of funds by the Navy Department in the amount of $8,340,000 for the purpose of finishing vessels now built. This sum is to be expended under the appropriation of $289,664,000, available for the fiscal year 1925. The ships effected by this activity include two airplane carriers, two light cruisers, seven first class submarines, three fleet submarines, two destroyer tenders, one submarine tender and one repair ship.

The appropriation bill also directs the Secretary of the Navy to prepare plans and estimates of the cost of a scout submarine and a submarine capable of accompanying the fleet, each to have the highest practicable speed and greatest desirable radius of action, such plans and estimates to be in readiness for submission to Congress on the first day of the next regular session.

Riter Conley Low Bidder for Building Six Steel Barges

WITH a price of $126,600, the Riter Conley Company submitted the lowest bid for six steel barges, at the opening of tenders on July 10, by United States Engineer Office, St. Louis, Mo. The following proposals were received:

Riter Conley	$126,600
Rock Island Bridge & Iron	137,340
Dravo	137,460
Nashville Bridge	152,400
Mid-West	152,400
Midland	153,600
American Bridge	165,000

Nashville Bridge Co. Low Bidder for Steel Hull for S. S. Colbert

WITH a price of $26,940, the Nashville Bridge Company, Nashville, Tenn., submitted the lowest proposal at the opening of bids, July 7, by United States Engineer Office, Nashville, Tenn., for the construction and delivery of one steel steamboat hull for *U. S. S. Colbert*.

The boat is to have a length overall of 138 feet 6 inches; length, molded, 120 feet; breadth, molded, 26 feet; depth at side, molded, 4 feet 5 inches. The following tenders were submitted:

Nashville Bridge Company	$26,940
Midland Barge Company	30,000
Dravo Contracting Company	32,870
Dubuque Boat & Boiler Works	35,000
Howard Shipyards & Dock Company	36,773
Charles Ward Engineering Works	49,800

Illinois Central Plans New Transfer Steamer

The Illinois Central Railroad, 135 East 11th Place, Chicago, Ill., will ask for bids soon on a sidewheel transfer steamer to be used at Helena, Ark. The dimensions are: Length, 270 feet; beam, 52½ feet; depth, 7 feet 9 inches. The engines are to be 25 inches by 8 feet. The vessel will have a twelve-car carrying capacity.

Specifications Due for Reconditioning of S. S. Egremont Castle

THE steamship *Egremont Castle*, which was recently sunk on the Bay Ridge flats to extinguish a fire, has been refloated by the Merritt Chapman Company and taken to Brooklyn, where her cargo has been discharged preliminary to survey for repairing damage. Specifications are expected to be in the hands of shipyards this week.

New Boats May Be Added to Southern Pacific's West Coast Equipment

The Southern Pacific Company has bought the principal interest in the Richmond-San Francisco Transportation Company which has established an automobile and commutation ferry service between San Francisco and Richmond, Calif. The improvements planned will necessitate an investment of about $2,000,000, which will include the amount necessary for boats.

Charles Ward Works Low Bidder for Maneuver Boats

The following bids were received by the United States Engineer Office, Huntington, W. Va., June 20, for two steel maneuver boats:

Charles Ward Engineering Works, Charleston, W. Va.	$33,050
Dravo Contracting Company, Pittsburgh, Pa.	39,380
Midwest Boat & Barge Company, Grafton, Ill.	39,550

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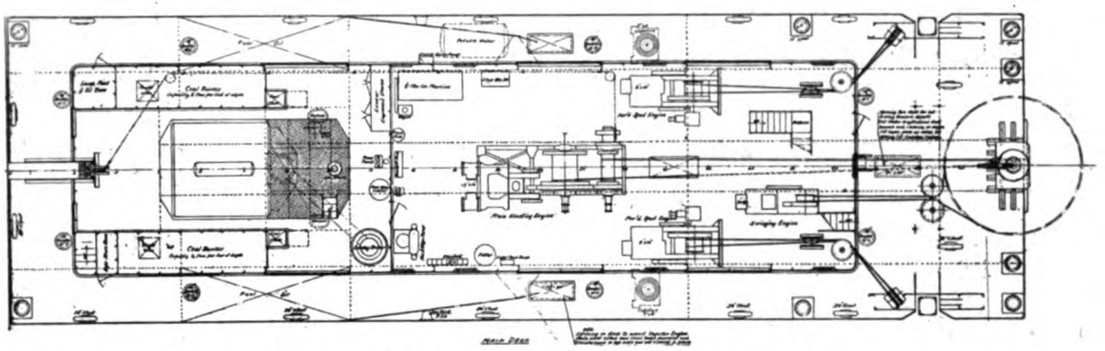

Arrangement Plan of Proposed Government Dredges

Bethlehem Awarded Contract to Re-boiler Two Passenger Ships

A CONTRACT for the construction and installation of eight boilers and involving the expenditure of a total of approximately $200,000, has been awarded the Bethlehem Shipbuilding Corporation by the Chesapeake Steamship Company of Baltimore, Maryland. The work is to be carried out at the Sparrow's Point plant of the Shipbuilding Corporation.

The boilers are to be of the three-furnace, Scotch type and are to be installed in the passenger and freight steamers, *City of Norfolk* and *City of Baltimore*.

Coast Guard Places $288,665 Business in Cabin Picket Boats

As a result of proposals opened on June 25, 1924, the United States Coast Guard has awarded a total of $288,665 in contracts for 36-foot cabin picket boats. The awards to July 2 have been made as follows:

Bidders	Units	Price Each
John M. Rogers Works, Gloucester City, N. J.	10 boats	$3,835
Coast Guard Depot, Curtis Bay, Md.	5 boats	4,025
Matthews Co., Port Clinton, Ohio	20 boats	4,094
Gibbs Gas Engine Co., Jacksonville, Fla.	15 boats	4,190
U. S. Navy Yard, Puget Sound, Bremerton, Wash.	10 boats	4,271
Freeport Point Shipyard, Freeport, L. I., N. Y.	10 boats	4,275

Lloyd Sabaudo Line Orders New Turbine Passenger Steamer

A CONTRACT for the construction of a new passenger ship for the Lloyd Sabaudo Line, has been awarded William Beardmore & Company, Ltd., Dalmuir, Glasgow, Scotland, according to Dr. M. Serrati, general manager of the New York agency of the line. The new ship will be named the *Conte Biancamano* and the order for her construction is a result of the increase in the company's South American trade. She will be the third of the Lloyd Sabaudo's "Conte" class ships and is to be a twin screw, oil burning vessel of 22,000 gross tons, driven by turbine engines, with a speed of 21 knots.

The *Conte Biancamano* will have accommodations for 400 first class, 200 second class and 1,000 third class passengers.

Steel Dredge Hull Awarded to Newport News Shipbuilding Co.

A CONTRACT for the construction of a steel hull for a suction dredge has been awarded the Newport News Shipbuilding & Drydock Company by the Atlantic Gulf & Pacific Dredging Company of 15 Park Row. The hull will have a length of about 162 feet and will cost approximately $75,000.

Order Placed for Oil Burning Equipment

The Peabody Engineering Corporation, New York, has received an order for the oil burning equipment to be installed in the boilers of the steamship *Mary Weems*, which is being converted from a freighter to a combination passenger and freight steamer by the Sun Shipbuilding Company for the Baltimore Steamship Company. The vessel is equipped with two 4-furnace, Scotch boilers, and her main engines develop 1,800 horsepower.

Dump Scow Contract

A contract for two steel dump scows has been awarded to the American Bridge Company, Pittsburgh, Pa., by the United States Engineer Office, Pittsburgh, at a price of $36,500.

September 1 Set as Tentative Date for Opening Dredge Bids

SEPTEMBER 1 is the tentative date of opening bids by United States Engineer Office, Louisville, Ky., for three steel hull dipper dredges, one without machinery for Nashville Engineer district for use on Cumberland River, delivery to be made at Paducah, Ky., and two dredges with all machinery for Louisville Engineer district with delivery at Louisville. Specifications will be ready for issuance by United States Engineer Office, Louisville, in the near future.

Contracts Placed for Diesel Tug Hull and Machinery

A contract for a directly reversible marine oil engine for a tug boat to be owned and operated by the Grace Lines, has been awarded to the Ingersoll-Rand Company, 11 Broadway. This engine is a 320 horsepower, 6 cylinder, 13-inch bore by 19-inch stroke and operates at a speed of 250 revolutions per minute.

The tug is being built by the Spedden Ship Building Company, Baltimore, Maryland and it is understood that the boat will be in service by the early Fall.

Outstanding features of the engine include direct-injection of fuel-oil; single lever control; and low head room; all features which are essential to a tug boat oil engine installation.

Federal Yard Wins Contract for Machinery Installations on Four U. S. Diesel Electric Dredges

A CONTRACT for the installation of bulkheads and electric dumping machinery on the four Diesel-electric hopper dredges of the United States Army Engineers, has been awarded to the Federal Shipbuilding and Drydock Company, at a total price of $134,700. Bids for the installation on one, two and four vessels were opened on June 26. The vessels concerned are the *A. Mackenzie* and *W. L. Marshall*, now at the Federal yard, and the *Dan C. Kingman* and *William T. Rossell* nearing completion at the Sun yard. The vessels have an overall length of 268 feet 5 inches and a deadweight capacity of 2,000 tons. The prices submitted were as follows:

	One Boat Price and Time	Two Boats Price and Time	Four Boats
Federal	$34,000 and 25 days	$67,490 and 35 days	$134,700
New York Harbor	33,670 and 38 days	66,607 and 45 days	129,481
Robins	36,000 and 30 days	69,000 and 45 days	136,000
Staten Island	38,200 and 36 days	75,500 and 40 days	150,000
Sun	74,000 and 45 days	148,000 and 55 days	296,000
Brooklyn Navy Yard	96,000 and 46 days	185,000 and 60 days	385,000

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Lake Ships Escape Heavy Damage From Recent Lorain Storm

MOST of the Lake Erie freighters and other shipping escaped the full force of the great tornado which swept along the lower shore of the lake, starting at Sandusky, and ceasing its destructive power beyond Erie, Saturday evening, June 28. Damage to freighters was very slight, even in the Lorain harbor. More than a dozen big ships have been held up in the harbor because of the strong river current.

The steamer *J. S. Ashley*, tied up in the yard of the American Shipbuilding Company, Lorain, parted her lines and the forward end was carried up on the dock. Wind crushed her wheel house and carried off the skylight over the engine room. The vessel was sent to Cleveland for repairs.

The Lorain plant of the American Shipbuilding Company was put out of business by the storm. The roofs are off a number of the main shops, but work of making repairs began at once. The damage was not heavy. The steamer *Lyman B. Smith*, tied up near the *Ashley*, was slightly damaged.

The Sandusky Cedar Point docks were badly damaged and the Sandusky Yacht Club, a two story frame structure, near the docks, was carried away, nothing being left but the foundation.

Pacific Coast Yards Bid for Construction of Gasoline Barge

SEALED proposals for the building of a gasoline barge to be used in the service of the Associated Oil Company on San Francisco bay, were opened recently by the Shipping Board on the West Coast. The bids were as follows:

Pacific Engineering Co., two bids	$29,960 and	80 days
	33,460 and	50 "
Todd Shipbuilding Co., Seattle	49,820 and	120 "
Los Angeles Shipbuilding & Drydocking Co.	44,880 and	60 "
Moore Drydock Co.	44,942 and	87 "
Bethlehem Shipbuilding Corp.	56,400 and	85 "
General Engineering & Drydocking Co.	57,633 and	130 "

Burned Steamer Sankaty May Be Replaced

Owing to the burning of the New England Navigation Company's steamer *Sankaty* on June 30th at New Bedford, it is reported in marine circles that there is a possibility of another vessel being built for replacement. The company's latest addition is the steamer *Islander*, recently completed by the Bath Iron Works, at Bath, Maine, and it is believed that if the *Sankaty* is replaced, it will be with a boat of this type.

The *Islander* is a 14 knot steel steamer having an overall length of 210 feet; breadth overguards 50 feet; depth, molded, 14 feet 6 inches; propelled by one four-cylinder, triple expansion engine of 1,200 indicated horsepower. The steamer has a passenger capacity of 1,960 persons.

Oil Engine Towboat

The Clyde Paden Company, Sardis, Ohio, has awarded a contract to the Mozena Boat Yard, Clarington, Ohio, for a new towboat 16 feet by 75 feet, with a 100 horsepower oil engine.

Principal Tonnage Building in American Shipyards July 1, 1924

(Recorded by American Bureau of Shipping)

Yard and Hull No.		Name	Gross	Owners	Mach. & H. P.		Dimensions			Fuel
American S. B. Co.	788	Henry Ford II	8,500	Ford Motor Co.	O.E.	3,300	586	62	32	Oil F.
Bethlehem S. B. Co. (Union Pl.)	5,322	.....	....	Hawaiian Meat.	Rec.	....	190	36	14	F.
	5,323	.....	....	San Fr. & Rich.	....	....	234	44	10	Oil F.
	5,324	.....	....	San Fr. & Rich.	....	....	234	44	10	Oil F.
	5,325	.....	....	San Fr. & Rich.	....	....	234	44	10	Oil F.
Federal S. B. Co.	81	.....	6,500	South Pac. Co.	Tb.	5,500	415	56	37	Oil F.
Great Lakes Engineering Co.	245	Benson Ford	8,500	Ford Motor Co.	O.E.	3,300	586	62	32	Oil F.
	247	.....	8,500	H. K. Oakes	Rec.	....	586	62	32	Col. F.
	248	.....	8,500	Columbia S. S. Co.	Rec.	....	586	62	32	Col. F.
Hanlon S. B. & D. D.	89	Dan F. Hanlon	1,700	Dan F. Hanlon	Rec.	1,400	...	...	...	Y.
Los Angeles S. B.	42	Catalina	....	Wilmington Tr. Co.	Rec.	3,600	301	52	21	Oil P.
Manitowoc S. B. Co.	210	Pere Marquette 22	3,000	Pere Marquette R.	Rec.	3,000	360	52	22	Col. C.
	211	.....	....	Ann Arbor Bt. Co.	Rec.	3,000	360	52	22	Col. C.
Moore S. B. Co.	167	.....	....	Associated Oil	O.E.	220	140	30	8	Oil Tb.
Newport News S. B. & D. D. Co.	274	Cherokee	5,300	Clyde S. S. Co.	Tb.	4,750	402	54	32	Oil P.C.
	275	Seminole	5,300	Clyde S. S. Co.	Tb.	4,750	402	54	32	Oil P.C.
	276	George Washington	5,300	Old Dominion S. S.	Tb.	4,750	376	53	30	Oil P.C.
	277	Robert E. Lee	5,300	Old Dominion S. S.	Tb.	4,750	376	53	30	Oil P.C.
	278	Coamo	5,000	N. Y. & Porto Rico.	(Data lacking)					
Pusey & Jones	1,028	.....	1,250	Norfolk St. Bt. Co.	Rec.	2,400	298	51	13	Col. P.C.
Staten Island	753	.....	560	City of New York.	Rec.	....	148	38	14	Oil F.
	754	.....	560	City of New York.	Rec.	....	148	38	14	Oil F.
	755	.....	560	City of New York.	Rec.	....	148	38	14	Oil F.
Sun S. B. & D. D.	59	A. L. Marshall	....	U. S. Engineers.	O.E.	....	269	46	27	Oil D.
	60	Dan C. Kingman	....	U. S. Engineers.	O.E.	....	269	46	27	Oil D.
	61	Wm. T. Rossel	....	U. S. Engineers.	O.E.	....	269	46	27	Oil D.
Tebo Yacht Bas.	32	.....	560	City of New York.	Rec.	....	148	38	14	Oil F.
	33	.....	560	City of New York.	Rec.	....	148	38	14	Oil F.
	34	.....	560	City of New York.	Rec.	....	148	38	14	Oil F.
Todd D. D. Co.	43	.....	8,500	Southern Pac. Co.	Tb.	6,000	445	57	27	Oil F.
Wm. Cramp S. & E.	509	.....	15,000	Amer. Haw.S.S. Co.	Elec.	24,000	554	76	45	C.

Principal Steel Tonnage Built in American Yards and Documented from January 1 to June 30, 1924

Name of Vessel	Gross Tons.	Type	Builder	Owner	Dimensions	Machinery and H. P.		Fuel
Alexander Hamilton	2,367	Pass. River	Bethlehem S. B. Corp.	Hudson River Day Line.	338.6x77.0x13.6	Recip.	4,000	Oil
Amsterdam Socony	1,199	Tanker	Sun S. B. & D. D. Co.	Standard Trans. Co.	252.9x40.1x12.8	Diesel	700	Oil
Boston	4,989	Passenger	Bethlehem S. B. Corp.	Eastern S. S. Co., Inc.	385.3x72.5x20.9	Turb.	6,400	Oil
Boston Socony	1,199	Tanker	New York S. B. Corp.	Standard Trans. Co.	252.9x40.1x12.8	Diesel	700	Oil
Burlington Socony	1,199	Tanker	Sun S. B. & D. D. Co.	Standard Trans. Co.	252.9x40.1x12.8	Diesel	700	Oil
Cincinnati	1,056	Packet	Midland Barge Co.	Louis. & Cin. Packet Co.	285.0x45.6x 7.5	Recip.	....	Coal
Gilbert	1,108	.....	Sturgeon Bay S. B. Co.	(Information lacking)				
Greater Buffalo	7,739	Passenger	American S. B. Co.	D. & C. Navigation Co.	519.0x58.0x23.6	Rec.	11,000	Coal
Greater Detroit	7,739	Passenger	American S. B. Co.	D. & C. Navigation Co.	519.0x58.0x23.6	Rec.	11,000	Coal
Hartford Socony	1,199	Tanker	New York S. B. Co.	Standard Trans. Co.	252.9x40.1x12.8	Diesel	700	Oil
J. H. Senior	1,155	Tanker	Newport News S. B. Co.	Standard Oil Co.	207.5x38.1x16.0	Diesel	700	Oil
New York	4,989	Passenger	Bethlehem S. B. Co.	Eastern S. S. Co., Inc.	375.0x72.6x21.0	Turb.	6,400	Oil
Oswego Socony	1,199	Tanker	Sun S. B. & D. D. Co.	Standard Trans. Co.	252.9x40.1x12.8	Diesel	700	Oil
Pere Marquette 21	2,992	Car Ferry	Manitowoc S. B. Co.	Pere Marquette R. R. Co.	348.0x46.0x16.0	Recip.	1,350	Coal
Priscilla	6,648	Passenger	New York S. B. Co.	New York S. B. Co.	419.5x56.5x32.8	Recip.	3,000	Oil
Providence Socony	1,199	Tanker	New York S. B. Co.	Standard Trans. Co.	252.9x40.1x12.8	Diesel	700	Oil
Rome Socony	1,199	Tanker	Sun S. B. & D. D. Co.	Standard Trans. Co.	252.9x40.1x12.8	Diesel	700	Oil
Schenectady Socony	1,199	Tanker	Sun S. B. & D. D. Co.	Standard Trans. Co.	252.9x40.1x12.8	Diesel	700	Oil
William K. Field	8,195	Freighter	Toledo S. B. Co.	Reiss S. S. Co.	580.0x60.0x32.0	Recip.	2,200	Coal
Yale	1,670	Freighter	N. J. D. D. Trans. Co.	Starin New Haven Line.	231.0x42.0x15.6	Recip.	1,600	Coal

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Shipping Board Places $369,000 Repair Work with Southern Yards

SHIPPING BOARD contracts for installation of new piping and other alterations, incidentals and repairs, on a total of twenty-two ships, at an aggregate value of $369,326, were placed in southern shipyards the first week in July. These contracts are in addition to $692.395 worth of similar business placed by the Board during the previous month.

The latest awards were the placing of sixteen ships with the Galveston Drydock Company, at a price of $15,500 each, in addition to fifteen vessels awarded the same company. Six ships have also been awarded to the Todd Shipyard Corporation's plant at Mobile, Ala., at a price of $20,221 each.

The award of these last twenty-two vessels completes the Shipping Board's program of re-piping alterations on a fleet of ninety-one Hog Island type vessels throughout the country.

Patrol Boat Contract Awarded at $228,000

A contract for ten 75-foot patrol boats, to be delivered on the West Coast, has been awarded to the Lake Union Drydock & Machine Works, Seattle, Washington, by the United States Coast Guard, at a price of about $22,800 each.

$242,500 Patrol Boat Contract Goes to Chance Marine Co.

The Chance Marine Construction Company of Annapolis, Md., has been awarded a contract for ten 75-foot patrol boats, by the United States Coast Guard, at a price of $24,250 each.

$50,000 Job Awarded Charleston Drydock Co.

The Charleston Drydock & Machine Company, Charleston, S. C., was the successful bidder for repairs to the Shipping Board steamer *West Harshaw*, at an approximate amount of $50,000.

Ferry and Barge

Captain J. A. Cresap, Moundsville, W. Va., has awarded a contract for a 65-foot barge to the Cook Brothers & Thomas Boatyard, Clarington, Ohio. This yard has also received a contract for a 40-foot propeller type ferryboat for the Clarington Ferry Company, Clarington, Ohio.

Shipmate Ranges for Patrol Boats

Wherever the Shipmate range is known, and that means wherever vessels are known, there will be no surprise at the fact that the 75-foot rum-runner chasers, contracts for 175 of which have recently been awarded by the U. S. Coast Guard to builders on the Atlantic, Pacific and Great Lakes, are all to carry Shipmates in their galleys. The ranges are now being shipped from the factory to the various shipyards.

New Diesel-Electric Tug

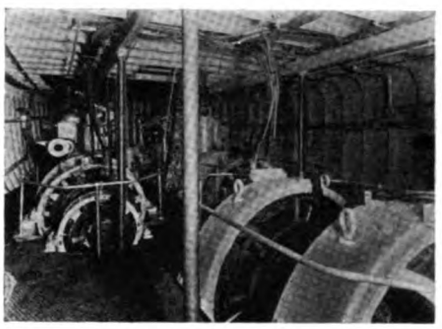
A Diesel-electrically propelled tug-boat was completed last month by the Staten Island Shipbuilding Company for the Pennsylvania Railroad System. The boat, which is known as *"P. R. R. Tug No. 16,"* is now

Diesel Electric Tug P. R. R. No. 16

receiving its dock and river trials in the Hudson River and Upper New York Bay.

The steel hull was delivered to the Pennsylvania Railroad System at its Hoboken Marine Yards, where the propelling machinery was installed and the tug outfitted.

The distinctive features of the propelling mechanism consist of two Winton Diesel oil-



Engine Room of P. R. R. No. 16

burning engines, each operating a Westinghouse generator to supply the electric current, which is then utilized to drive a Westinghouse 575 shaft horsepower motor, turning the screw propeller. The Ward-Leonard system of pilot house control, which permits direct control of the propeller wheel by the skipper, has been installed. *"Tug No. 16"* is 105 feet in length, 24 feet beam, and draws 12 feet of water.

Converting Submarine Chaser

According to a contract awarded to Elliott's Shipyard, the Houston Pilots' Association, Houston, is converting a former 110-foot submarine chaser into a first class pilot boat. The boat will be finished in about two months and will be known as the *Houston Pilot No. 2.* The former chaser has a length of 110 feet; beam 15 feet; depth 9 feet. When conversion is completed she will draw 5 feet 4 inches.

River Ferry Contract

The Kennedy Drydocks, Memphis, Tenn., has received a contract to build a new ferryboat for use on the Mississippi River at Arkansas City, Ark.

World's Shipbuilding Gains 100,000 Tons Over Last Quarter

WORLD shipbuilding in the aggregate shows a gain of 100,000 tons over the total at March 31 last, according to Lloyd's returns for the quarter ended June 30. Great Britain and Ireland gained 43,000 gross tons, as compared with a loss of 16,000 tons for the United States, and a gain of 73,000 tons for all other countries combined. The comparison of orders now and at the end of March is shown in the following table, the figures representing gross tons:

	June 30	March 31
United States	103,665	119,767
Great Britain and Ireland	1,516,746	1,473,629
Other Countries	996,486	923,108
World Total	2,616,897	2,516,504

NEW ORDERS EXCEED OUTPUT

There are a number of encouraging features in the present returns. New work exceeded launchings by 90,000 tons. The steady growth of the motorship in favor is shown by the fact that on June 30 there were being built throughout the world more than 800,000 tons of this type of vessel, as compared with less than 700,000 tons on March 31. Motorship construction now represents not far from a third of the entire shipbuilding of the world. Tanker construction (including steam and motor-propelled vessels) shows a slight decrease from the March 31 total, only 180,170 gross tons of this type of vessel now being under construction.

DISTRIBUTION OF SHIPBUILDING

There was some shifting in the ranking of shipbuilding countries during the past quarter. Great Britain and Ireland continue to hold first place by a wide margin, with Germany still second; but France, which stood fifth in construction orders in hand on March 31, is now third. Italy has gone from third place to fourth, and the United States from fourth to fifth, Holland, Japan and the British Dominions continuing to rank sixth, seventh and eighth, in the order named. Great Britain and Ireland, Germany, France and the British Dominions are building more tonnage than at the end of March and the others less. Germany's gain of 41,000 tons was accompanied by one of 33,000 tons for France and about 8,000 tons for the British Dominions.

The volume of world shipbuilding is slightly higher than it was a year ago, but the bulk of the gain has been by British shipyards, other countries showing a loss from the June, 1923, figures. The lowest level since the late war was reached in the quarter ending September 30, 1923, when the world total was nearly a quarter of a million gross tons below the present figure. Since that time there has been a slow, but steady gain.

Fifty-eight percent of the world's shipbuilding is now being done in Great Britain and Ireland, 13 percent in Germany, 4 percent in the United States and 19 percent in the other countries combined.

New O. D. Ship to Be Launched on August 20

The new liner *George Washington*, of the Old Dominion Steamship Company, will be launched August 20 at the yard of the Newport News Shipbuilding and Drydock Company. The new steamship is the first of two under construction for the company's service between New York and Norfolk. The second, the *Robert E. Lee*, will be launched early in October.

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Reports from French Steamship Companies Show Slight Gains

By Our Paris Correspondent

IN the June issue I alluded to the retirement of Mr. Rio, the Under Secretary of State for Mercantile Marine, following the decision taken by Mr. Poincare to suppress all Under Ministries when constituting his second Cabinet. The chief event of June, as far as the French shipping policy is concerned, has been the restoration by Mr. Herriot, the new French Prime Minister, of the Under Secretariate of State for Merchant Marine, which has been placed within the dependence of the Ministry of Commerce in lieu of being subordinated as previously to the Ministry of Public Works. The new Under Secretary of State for Mercantile Marine is Mr. Leon Meyer, the mayor of Havre. It is noteworthy that that measure has met with the approval of most of those concerned in the shipping industry in this country.

Although some recent reports have shown that there were notable signs of improvement in the operation of the shipping trade, the new Under Secretary of State will have much to do in reviving that industry which is still confronted with severe problems.

Laid-Up Tonnage Decreases

An important decrease in the number of laid-up vessels is shown by the returns of laid-up tonnage in French ports on April 15, which was published early in June. The number of laid-up vessels on that date totaled 263, aggregating 389,410 tons gross, as compared with 332 vessels aggregating 447,879 tons on January 15, 1924, and 371 vessels aggregating 546,916 tons on October 15, 1923.

This improvement in the conditions of sea trade has been confirmed by the reports of most of the French steamship companies on their operations for 1923. The increase in the receipts of the Compagnie Generale Transatlantique for instance, has enabled that firm to pay a dividend of 5 percent for 1923, while no dividend was paid for 1922. During the first six months of 1924 the company has had a notable increase in receipts from fares and freights but at the same time the company has suffered from the protectionist measures taken by several foreign governments and notably by the United States in respect to immigration. The company's new one-class liner *De Grasse*, under construction at the yards of Messrs. Cammell Laird, is scheduled to sail on her maiden voyage from Havre to New York on August 21. Full particulars regarding that vessel were given in the May issue. As regards the new big liner of the enlarged *Paris* type, which is to be built to the account of the French Line, it is reported that the long expected order has not yet been placed.

Less gratifying statements come from the Messageries Maritimes. The accounts of this company for 1923 show a deficit of 2,260,000 francs. Although most of laid-up vessels have been recommissioned, many voyages have been unprofitable.

Another important development relative to shipping which took place in June was the constitution of a joint committee to be known under the title of "Comite Paritaire Permanent de la Marine Marchande" which is intended to prevent the occurrence of troubles or contests in maritime labor. The first meeting of that committee, which was held on June 16, was presided over by Mr. Leon Meyer, the new Under Secretary of State for Merchant Marine.

French Naval Architects Meet

At the meetings of the French Institution of Naval Architects, held on June 4, 5 and 6, the program included interesting papers on "Electric Propulsion," by Mr. Foillard; "Reduction Gearings, and the Statical Balancing of Turbine Disks," by Mr. Delaporte; "The use of Flax-Seed for the Disincrustation of Boilers," by Mr. Pluyette; "Surface Condensers," by Mr. Ginabat; "The Gyroscopic Stabilisator," by Mr. Battestini; "Stability Trials," by Mr. Thooris, etc.

The extreme scarcity of orders for new vessels continues to be the feature of the shipbuilding outlook on this side. The only important order recorded in the course of the last few weeks was that relative to the construction of three cargo vessels of 3,600 tons deadweight to be built by the Chantiers de Saint-Nazaire Penhoet to the order of the Compagnie Generale d'Armements Maritimes.

Launchings and Trial Trips

On June 14 there was launched from the yards of the Forges et Chantiers de la Mediterranee the passenger steamer *Marechal-Lyautey*, 130 meters long, built to the account of the Compagnie Paquet, for service between Marseilles and Morocco. The same builders delivered some weeks ago to the Compagnie Fraissinet, Marseilles, the combined passenger and cargo steamer *Hoggan*, 123 meters long, 15.25 meters beam and 8.64 meters depth, with a displacement of 8,556 tons; the propelling machinery consists of one triple expansion engine developing 3,800 horsepower. Passenger accommodations are provided for 88 passengers. A sistership, the *Touareg*, has just been delivered to the same owners by the Chantiers de Provence; both vessels are to be placed into service on the French western coast of Africa line.

The *Camranh*, built by the Chantiers de la Loire to the account of the Chargeurs Reunis, which is the first French motorship (two Sulzer engines) ran her speed trials in July. The first French motor passenger vessel, which is being built by the Chantiers de France to the account of the Messageries Maritimes, will be named *Theophile-Gautier*.

The cable-ship, *Cyrus-Field*, built by the Chantiers et Ateliers de Saint-Nazaire-Penhoet to the order of the Western Union Telegraph Company, also ran her speed trials early in July.

New Shipyard at Seattle

Plans have been completed by the Crosby Marine Corporation, Seattle, Washington, for the construction of a new wooden shipbuilding yard on Salmon Bay.

The new yard will be located on a part of the site of the war-time plant of the Meacham & Babcock Shipbuilding Company, and will include No. 1 ways of that yard.

Mr. Crosby, president of the corporation, stated that the new company has a contract for a Diesel-powered tugboat, to be built for Henry Finch, which will be sixty-five feet long overall. The company also has contracts for the construction of two large scows and expects to close a contract in the near future for another vessel.

Shipyard Sale Approved

The bid of $516,000, made by Henry K. Fort, of Philadelphia, for the shipyard plant of Pusey & Jones, located at Gloucester City, N. J., and in the hands of receivers, was approved by Federal Judge Lynch at Newark. Originally it is said to have cost Christoffer Hannerig and associates about $5,000,000.

Colorado Exceeds Contract Speed on Official Sea Trials

THE electrically propelled super-dreadnought *Colorado* successfully completed her official trails on July 10 under the direction of Rear Admiral C. H. Burrage, U. S. N., president of the Board of Inspection and Survey.

The final trails were held off Cape Cod and consisted of an eight-hour, full power run, a four-hour economy run, reversal speed at 16 knots, steering test at 16 knots, astern to ahead at 16 knots without giving signals, full power steering ahead, reverse full power, steering astern at full power, reverse astern to head, steering test on auxiliary electric gear, making tactical diameters and the figure eight.

The most spectacular of these was when the 32,600 ton dreadnought was reversed from a speed of 21 knots ahead to full power and speed astern. The vessel came to a dead stop in approximately three and a half minutes within a distance of a thousand yards. The four screws, still reversing at full power and speed, sent the *Colorado* astern at a speed of about 17 knots.

Maximum Speed 22.06 Knots

In the full speed trials run over the standardization course off Rockland, Maine, the *Colorado*, with a 1,500-ton excess tonnage, exceeded her contract speed at 21 knots by maintaining an average speed of 21.27 knots for three consecutive full power runs. She attained a maximum speed of 22.06 knots developing 37,400 shaft horsepower at about 180 revolutions a minute, a record for ships of her class.

Propelling Machinery

The propelling machinery consists of four Westinghouse 8,375 horsepower induction motors supplied with power by two Westinghouse 15,000 K. V. A. turbine generators. Steam is generated by oil-burning boilers.

The *Colorado* was built by the New York Ship Building Corporation, Camden, N. J. Her keel was laid before the World War and the ship was finished in accordance with the Naval Limitations Treaty. She is 624 feet long, displaces 32,600 tons, has a speed of 21 knots, and embodies all the latest ideas for protection against submarine and airplane attacks.

New Pier for Philadelphia

A contract has been awarded to the Fred Snare Corporation by Director Biles of Philadelphia, for the construction of a modern flat pier at the Northeast Sewage Works, Wheatsheaf lane and the Delaware River, at an estimated cost of $600,000.

To Improve Terminals

The sum of $400,000 has been allotted by the United States Shipping Board for the improvement of the Charleston Port terminals. The funds for this work are to be allocated from operating funds set aside for this purpose.

Boat Yard Expansion

Plans are being prepared by the Gasconade Boat Yards, Gasconade, Mo., for extensive improvements to its boatyard, to exceed $100,000, including equipment.

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I. M. M. Net Profits Reduced Last Year

A PROFIT of $3,889,878.48 after deduction of expenses, taxes and bond interest is shown by the International Mercantile Marine in its report for the calendar year 1923 submitted by P. A. S. Franklin, president of the company, at the annual meeting of the stockholders last month. This represents a decline of $824,-968.59 as compared with last year, and a deduction for depreciation on steamers amounting to $5,579,800.46, leaving a deficit of $1,689,921.98, as compared with a deficit of $1,269,783.78 in 1922.

Receipts of the parent company, including dividends received from its subsidiary companies out of their earnings for the year 1923 and prior thereto and returns from the operation of the steamers it owns directly, show an estimated profit amounting to $794,-698.09 for 1923 after deducting all expenses, bond interest and depreciation on the steamers directly owned.

"As stated in the last annual report," says Mr. Franklin, "until the political situation in Europe materially improves and the present serious economic conditions are corrected, it is impossible to expect a resumption of normal interchange of freight and passenger traffic between the countries of the world and as there has been no improvement abroad, the business of your companies has been both difficult and unsatisfactory. In addition to this we have had very serious competition from Government-owned steamers operated regardless of financial results.

"The new immigration bill to take effect July 1, will still further reduce the number of immigrants that can enter this country and there will be a consequent loss of revenue to the company.

"We regret to say that the expenses of operating the steamers are not decreasing, owing to the higher cost of labor and also to continued high cost of fuel.

"It is too early to predict results for 1924, but so far they have been more satisfactory and we are hopeful that with an improvement in conditions in Europe there will follow a general revival of business and trade throughout the world. Shipping should then be able to gradually work itself out of its present difficulties and as the company's fleet has been maintained in a highly efficient state and our position in the various trades thoroughly protected, we feel confident that we will be able to benefit by such improvement when it takes place. We are not building any new ships as we do not consider it warranted.

"In 1913 our steerage passengers numbered 1,300,000, while under the new immigration bill we are cut down to 161,000. In 1923 our first class passengers numbered about 75 percent of the pre-war number, being about 77,000 each way. In 1924 we expect first class business to be about 80 percent of normal."

Argentine Plans New Dock

According to a report from Ambassador J. W. Riddle, Buenos Aires, an agreement has been entered into between the Government of Santa Fe and the Argentine National Government for the construction of a new dock at the port of Santa Fe. This dock is to be utilized exclusively for coastal and fluvial shipping and its estimated cost is 1,350,000 paper pesos (the paper peso is now worth $0.325), of which 550,000 is to be provided by the Provincial Government and 800,000 paper pesos by the National Government.

Dravo Starts Dock Job

The Dravo Contracting Company, of Neville Island, Pittsburgh, which is to construct a coke unloading dock for the Carnegie Steel Company's plant at Mingo Junction, Ohio, on the Ohio river, has started construction work. The dock will be 1,650 feet long and the tower unloading dock will be 360 feet long. The device will have a daily unloading capacity of 2,000 tons. The contract also calls for the construction of ice breakers and 14 mooring clusters. About 120 piles 70 feet long will be required and the work will require five or six months.

Steamship Operations

Announcement has been made by the Moore & McCormack Steamship Company that Philadelphia is to have another steamship service to points in Texas and Florida. Service to Freeport, Texas, began with the departure from Philadelphia on July 22 of the steamship *Freeport Sulphur No. 5* for the Texas city via New Orleans.

A regular monthly freight service from the Mediterranean to Boston will be maintained by the Cosulich Line, beginning with the sailing of the *Columbia*, Saturday, July 19, from Trieste.

Information has been received from the Scandinavian-American Line of the removal of the steamship *Frederik VIII* from the New York-Copenhagen route as a result of curtailment of immigrant traffic. The ship is to be employed temporarily in the transportation of tourists from Denmark to the British Empire Exposition at London.

The 15,000 ton passenger liner *Aurania* of the Cunard Line, will sail on her maiden voyage September 27, from Liverpool to New York. This vessel has been specially constructed for the St. Lawrence route and will take her place in the regular run out of Montreal to the United Kingdom.

Ownership Transfers

The steamers *Sururga*, 7,455 deadweight tons, and *Dochra*, 7,100 deadweight tons, have been sold by the Barber Steamship Lines to C. N. Hansen's Sons of Copenhagen, and the steamer *Satsuma* has been sold to Italian interests for scrapping purposes, by the Barber Lines. The actual sale price of these vessels could not be obtained.

The battle cruiser *New Zealand*, presented to the mother country by the New Zealand Government, has been sold in England for $100,000. The cruiser cost eight and one-half million dollars to build.

The sale of three tugs was announced recently at the Maritime Exchange. The *Charles Runyon*, sold at public auction to J. C. Reichert for $1,200, the *H. B. Rawson*, sold at public auction for $1,700 to the Dauntless Towing Company, and the *Neponset*, sold at public auction at Tebo's Yacht Basin Company's plant to Edward Card, Jr., for $1,800.

The schooner *Riviera* was sold at public auction at Port Newark to Burleigh Brooks of New York for $4,300.

The derrick *Will* was purchased by Oswald Quinlivan at a sale at North Bergen for $800, and at the same sale the derrick *April* was purchased by Charles W. Peterson for $850.

The former China Mail liner *Nile*, sold last year to Rosenthal Brothers of Oakland, Calif., has been re-sold to M. A. Bernardini, of Los Angeles, Calif., for $100,000.

Port Developments Planned at Pittsburgh

The Secretary of War has approved the appropriation of $1,400,000 for the maintenance and improvement of the Monongahela river at Pittsburgh. According to Major E. L. Daley a small sum has been alloted for channel work on the Allegheny river and $14,000 for maintenance of work suspended during the raising of the bridges over the Allegheny river.

New Rockaway Pier

Mayor Hylan of New York has given his approval for a new $500,000 pier at the foot of Rockaway Parkway. The pier was made necessary by the decision to extend the main channel of the Jamaica Bay improvement to Canarsie.

New Incorporations

The Dollar Freight Terminal Company has been incorporated under New York laws with a capitalization of $1,000,000. I. A. Campbell, S. A. Oyen and G. A. Rush, incorporators.

The Interocean Fruit Corporation has been incorporated under Delaware laws with a capitalization of $100,000.

The Roosevelt Steamship Agency has been incorporated under Delaware laws with a capitalization of $50,000. Arthur Skillman, New York; E. K. Raychie, Astoria, New York, and E. Sellette, Brooklyn, New York, incorporators.

The Steamer Hadnot Corporation, passenger boats, with a capitalization of $123,000, has been chartered under New York laws.

Under Albany laws, the New York Tank Barge Company has been chartered with a capitalization of $50,000, to equip boats, by W. H. Baldwin, A. Kaufman and R. Klunk.

TRADE PUBLICATIONS

THE SPEEDNUT WRENCH.—An entirely new type wrench, which automatically adjusts itself to all sizes and shapes of nuts is illustrated and described in a folder issued by the Speednut Wrench Company, Ltd., 20 East Jackson Boulevard, Chicago, Ill.

STEEL PLATES.—The Lukens Steel Company, Coatesville, Pa., has issued a series of three bulletins describing products of this company, including pressed and stamped steel parts, details of the largest one-piece flanged boiler head in the world and locomotive firebox plates.

DIPPING DANGERS.—The application of Foamite fire protection to dipping tanks, tempering vats, open oil storage and the like is described in a bulletin prepared by the Foamite-Childs Corporation, 629 Turner street, Utica, N. Y. The effect of Foamite in extinguishing fires is ably described by means of numerous illustrations.

GENERAL ELECTRIC COMPANY.—A pictorial record of the plant and operation of the General Electric Company at Schenectady, N. Y., the works at Lynn, Mass., and at Erie, Pa., Fort Wayne, Ind., Pittsfield, Mass., Bridgeport, Conn., Harrison, N. J., and Cleveland, Ohio, is contained in catalogue Y 863-B recently issued by the company.

ELECTRIC FANS.—A pamphlet prepared for stockholders of the General Electric Company on the subject of electric fans and methods of promoting their use has been issued

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by the General Electric Company, Schenectady, N. Y. Illustrations are given of the various type fans produced by the G. E. Company.

Bearing Metals.—The Magnolia Metal Bearing Book, containing a discussion of Magnolia anti-friction metal together with simple practical instructions for the making and operation of lined bearings for efficient and economical service, has been published and is now being sold by the Magnolia Metal Company, 113-115 Bank street, New York.

Welding Equipment.—A new 48-page catalogue, illustrating and describing in detail the complete line of acetylene generators and oxy-acetylene welding, cutting, brazing, lead burning, heating and decarbonizing equipment manufactured by the Oxweld Acetylene Company, Long Island City, N. Y., is now available for distribution to all those interested in the subject of gas welding.

Electric Welding of Large Storage Tanks.—A reprint of a paper read by Harold C. Price, presented before the American Institute of Mining and Metallurgical Engineers at the New York meeting in February, 1924, on the subject of "Electric Welding of Large Storage Tanks," has been sent out by the Wilson Welder & Metals Company, Inc., Hoboken Factory Terminal, Hoboken, N. J.

Heavy Oil Engines.—Bulletin 32 prepared by the Bethlehem Shipbuilding Corporation, Ltd., Bethlehem, Pa., discusses the Bethlehem-Trout heavy oil engine, its advantages and application, together with specifications of the engines, which are available in units from 75 to 480 horsepower direct drive for marine service and from 50 to 480 horsepower in generator drive for stationary service.

Fuel Oil Burning.—The text-book employed by the Todd Oil Burning School, conducted by the Todd Shipyards Corporation, New York, has been made available to all those who are interested in the matter and will send a request for it. This book gives data on fuel oil and its characteristics, the chemistry of combustion and specific instructions regarding the operation of oil burning equipment.

Galley and Pantry Equipment.—Elisha Webb & Son Company, 136 South Front street, Philadelphia, manufacturers of galley ranges, bake ovens, broilers, steam cookers, jacket kettles, coffee and tea urns, steam tables and cooking apparatus of special design for steamships, yachts, tugs and vessels of every description are specifically described and listed in a bulletin now availabe on a request to the company.

Heine Boilers.—Under the title of "In the Footsteps of Old Masters" the Heine Boiler Company, St. Louis, Mo., in a new bulletin gives the history of a boiler which has been in the service of the Berkey & Gay Furniture Company at Grand Rapids, Mich., for forty years and is still in daily operation at its original pressure. Several illustrations taken in the plant of the Heine Boiler Company with a list of boiler types made by the company are also contained.

Nordberg Diesel Engines.—The Nordberg Manufacturing Company, Milwaukee, Wis., is distributing a reprint in catalogue form from the "Diesel and Oil Engineering Handbook" describing in great detail the Nordberg-Carels type of Diesel engine. This company has been engaged in the manufacture of Diesel engines for over ten years, having obtained the American rights for the two-cycle type built by the Carels Bros. of Ghent, Belgium, who have designed and built Diesel engines for twenty-five years. This company is now equipped to build engines ranging from 330 to 6,000 brake horsepower in units of from 3 to 6 cylinders. Complete details and construction drawings with illustrations of various size engines and installations are contained in the catalogue.

Mayari Pig Iron.—What constitutes a handbook of Bethlehem Mayari Pig Iron, a natural nickel chromium alloy iron for making high grade castings, is listed as publication No. 26 and is now for sale by the Bethlehem Steel Company, Bethlehem, Pa. Two articles by Dr. Richard Moldenke, international authority on foundry work, have been included in this book. The physical and chemical properties, structure, test and application of this type pig iron are given.

Blacker Hammers.—A new catalogue, describing the Blacker "B" blacksmith hammer, with suitable illustrations of various types operating on the same principle, has been prepared by the Blacker Engineering Company, Grand Central Terminal, N. Y. The special feature of this hammer is that it travels over the anvil face, thus making hand forging operations and utility smithing possible without helpers. Illustrations of forging work done with this hammer are contained in the catalogue.

Better Foundry Practice.—A booklet taking up the construction, location and layout of a building to be devoted to foundry work has been prepared by the Policyholders' Service Bureau, Group Insurance Division of the Metropolitan Life Insurance Company, New York. This bulletin is the first of a series of ten and deals particularly with the layout of foundry departments, storage of materials, productive departments, multi-story foundries, types of roof and flooring, methods of heating, lighting and ventilation systems.

Condenser Tubes.—A reprint of a paper on condenser tubes, presented at the November 8, 1923, meeting of the Metropolitan Section of the American Society of Mechanical Engineers by William R. Webster, vice president of the Bridgeport Brass Company, Bridgeport, Conn., has been made up in catalogue form and is now being distributed by the company. Few problems relating to the operation of steam power plants, both marine and stationary, involve greater perplexities than those surrounding the endurance of the tubes employed in surface condensers where salt or contaminated cooling water is used. The paper deals with the failures to which condenser tubing is exposed and the methods taken to prevent these failures by the use of correct composition alloys. Numerous microphotographs are shown to bring out the points emphasized by the author.

MARINE SOCIETIES

AMERICA

American Society of Naval Engineers
Navy Department, Washington, D. C.
Secretary-Treasurer—Commander Bryson Bruce, U. S. N., Bureau of Engineering, Navy Department, Washington, D. C.

Society of Naval Architects and Marine Engineers
29 West 39th Street, New York
Secretary and Treasurer—Daniel H. Cox.

National Association of Engine and Boat Manufacturers
29 West 39th Street, New York City
Secretary—R. R. A. Hand.

United States Naval Institute
Naval Academy, Annapolis, Md.
Secretary and Treasurer—Commander H. K Hewitt, U. S. N.

American Marine Association
15 Park Row, New York
President—Frank J. Shipman.

The New York Tow Boat Exchange
11 Moore St., New York.
Secretary—Irving G. Keller.

Port of New York Authority
11 Broadway, New York
Chairman—E. H. Outerbridge.
Secretary—William Leary.

National Association of Masters, Mates and Pilots
National Secretary—M. D. Tenniswood, 308 Vine St., Camden, N. J.

American Society of Marine Designers
Secretary—B. G. Barnes, 202 Kendrick Ave., Quincy, Mass.

National Marine Engineers' Beneficial Association
Headquarters 311-315 Machinists Building.
Washington, D. C.
Secretary-Treasurer—George A. Grubb.

Atlantic Coast Shipbuilders' Association
1600 Walnut Street, Philadelphia, Pa.
Secretary—C. S. King.

Council of American Shipbuilders, Inc.
30 Church St., New York
President—Homer L. Ferguson.
Secretary-Treasurer—Henry C. Hunter.

American Steamship Owners' Association
11 Broadway, New York
President—Alfred Gilbert Smith.
Vice-President and General Manager—Winthrop L. Marvin.

United States Ship Operators' Association
149 Broadway, New York
President—C. H. Potter.

National Merchant Marine Association
Munsey Bldg., Washington, D. C.
President—Hon. J. E. Ransdell.

The Maritime Association of the Port of New York
78 Broad St., New York City
President—Charles H. Potter.
Secretary—Walter F. Firth.

Lake Carriers' Association
President—Wm. Livingstone, Dime Bank Building Detroit, Mich.
Secretary—George A. Marr, Rockefeller Building. Cleveland, O.

Neptune Association
21 Pearl St., New York City
Secretary-Treasurer—Captain John F. Milliken

Ocean Association of Marine Engineers
15 Whitehall St., New York City
Secretary—Bert L. Todd.

CANADA

Grand Council N. A. of M. E. of Canada
Grand Secretary-Treasurer—Neil J. Morrison, Box 886, St. John, N. B.

GREAT BRITAIN

Institution of Naval Architects
Adelphi Terrace, London, W. C.

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